SEPTEMBER 9, 1961

Chemical Week

A McGRAW-HILL PUBLICATION PRICE FIFTY CENTS

Germany's Big Three

Special Report .....p. 45

U.S. capital spending abroad. New data pegs CPI's plans ....p. 37

Chemicals aim for outer space. Propellant progress report p. 105

Dallas polishes its attractions for CPI

STEVENS RICE GS CH
UNIVERSITY MICROFILMS INC
313 N 1ST ST
ANN ARBOR MICH

WHY ROCK HILL
uses superior quality Mutual Sodium Bichromate

For economy and handling ease, Rock Hill Printing & Finishing Co., a division of M. Lowenstein & Sons, Inc., uses Mutual® Sodium Bichromate as an oxidizing agent in high-style cotton prints like the one shown. Whatever your application, you too can enjoy the excellent handling characteristics of this granular product.

Mutual Sodium Bichromate is available in both granular and solution form, and in a variety of packages to insure the most efficient and economical application to your processing needs. Solvay technical service men can help you choose wisely—and aid in applying the product to your process.

For a complete description of Mutual Sodium Bichromate and the full line of Mutual Chromium Chemicals write for your free copy of Solvay's new 80-page technical bulletin, "Chromium Chemicals." It contains detailed information on uses and properties with comprehensive technical data.

MUTUAL CHROMIUM CHEMICALS
Sodium Bichromate • Sodium Chromate • Chromic Acid • Potassium Bichromate • Potassium Chromate • Ammonium Chromate • Koreon (One Bath Chrome Tan)

SOLVAY PROCESS DIVISION
61 Broadway, New York 6, N. Y.

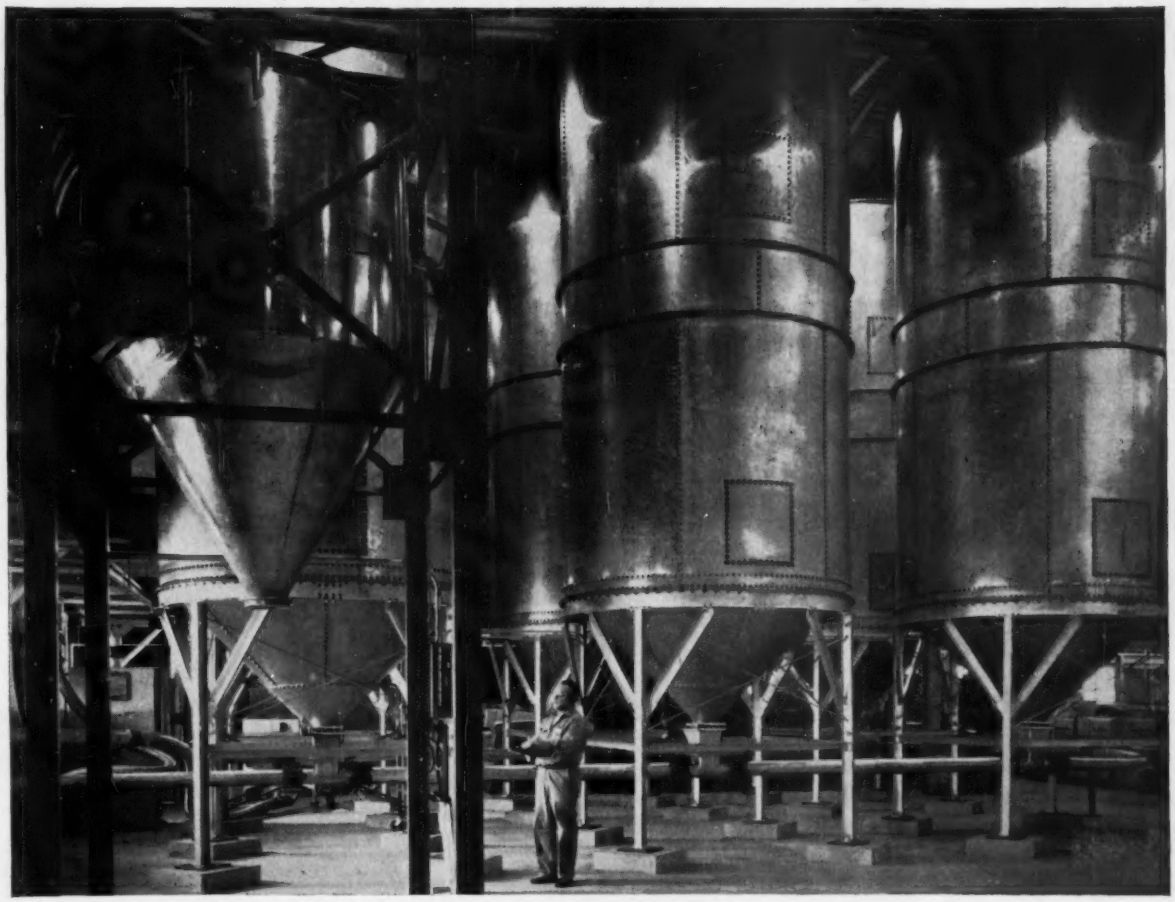
Allied Chemical

PUSH COSTS DOWN

MOVE UP TO MODERN HANDLING

meet all bulk handling requirements

...with Dracco Airstream Conveyors



Seven *bulk handling jobs are performed by* **one** *Airstream Conveyor System at this eastern plastic film plant. In meeting all handling requirements, this versatile system provides what the company wants in:*

handling flexibility—Polyethylene pellets are unloaded from (1) hopper cars, (2) collapsible rubber bins, (3) bags . . . moved (4) to any storage bin, (5) directly to load-cell weigh bin, (6) from one bin to any other, or (7) from storage to process.

lower materials costs—Four per cent saving through bulk buying paid for Airstream System in less than three months.

contamination-free handling — Completely enclosed, self-cleaning system protects product purity, prevents intermixing of materials.

operating economy—One-man operation, low maintenance keep handling costs low.

expandability—Existing conveyor system can be expanded, at minimum engineering cost, to keep pace with plant enlargement and increased production needs.

• • • • •

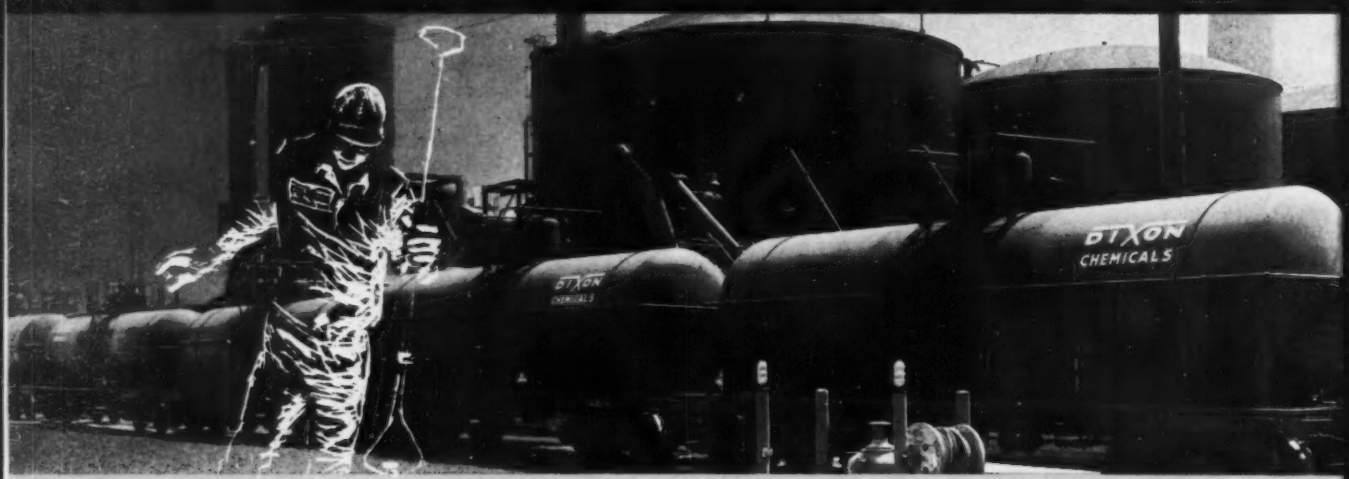
These are the benefits gained by moving up to modern handling. Now it's your move! For the specialized help you'll need, call in: Dracco Division of Fuller Co., Harvard Ave. and East 116th St., Cleveland 5, Ohio.

See Chemical Engineering Catalog for details . . . or write for 32-page Bul. 530, "Dracco Airstream Conveyors".

DRACCO *airstream* conveyors
dust control equipment

FULLER COMPANY

DIXON ACID CUSTOMERS ARE ALWAYS*



* **Treated as customers ! ! !**

DIXON
CHEMICALS

Most of our business comes from industrial buyers who know that they receive high quality mineral acids produced by the finest technological skill utilizing the most modern process techniques available.

Dixon customers *stay* with Dixon because large or small, old or new, they always get the service they expect.

EXECUTIVE OFFICES: DIXON PARK, BROAD STREET, CLIFTON, N. J. PRescott 3-6300

ON THE COVER: Against a background of German national colors are shown the emblems of that nation's three major chemical companies. For their story, see p. 45.

Chemical Week

Vol. 89, No. 10 SEPTEMBER 9, 1961

7 LETTERS

12 MEETINGS

33 BUSINESS NEWSLETTER

37 **Mushrooming foreign investment marks U.S. companies plans for '61-'62.**

39 Too remote for heavy chemicals, Maine bids for build-up in specialties.

39 Armour borrows $32 million to push ahead on big chemical ventures.

39 TVA says it has sites, resources for six or more hardwood pulp mills.

40 Number of unincorporated chemical firms drops—but survivors prosper.

43 WASHINGTON NEWSLETTER

45 **SPECIAL REPORT—Germany's Big Three—their growth, their plans.**

57 **MARKETS—Helium recovery plan is boon to space age chemical processing.**

72 **SALES—Growing problem for international companies: finding qualified staffs.**

79 **SPECIALTIES—Synthetic latex binders for paper win new markets despite cost.**

82 Stull Chemical devises portable sprayer for use with invert herbicides.

89 TECHNOLOGY NEWSLETTER

93 **PRODUCTION—Here's short lesson in pluses, minuses of teaching machines.**

99 MARKET NEWSLETTER

105 **RESEARCH—Distant goals, at-hand gains mark space propulsion research.**

115 **ADMINISTRATION—Dallas: its 50-year plan includes a lot more CPI.**

125 **ENGINEERING—Rhodia's volatile catalyst bids for sulfide odor control jobs.**

126 Combined distillation-tower-heat-exchanger promises process savings.

130 BUSINESS BENCHMARKS

Chemical Week (including Chemical Specialties and Chemical Industries) is published weekly by McGraw-Hill Publishing Co., James H. McGraw (1860-1948), founder. EXECUTIVE, EDITORIAL, CIRCULATION AND ADVERTISING OFFICES: McGraw-Hill Building, 330 West 42nd St., New York 36, N. Y. Telephone, LO 4-3000; Teletype, TWX N.Y. 1-1636; Cable, McGRAWHILL, N.Y. Place of publication: Philadelphia, Pa. Second class postage paid at Philadelphia. (See below for directions regarding subscriptions or change of address.) OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, president; Shelton Fisher, Wallace F. Traendly, senior vice-presidents; John R. Callaham, vice-president and editorial director; Joseph H. Allen, vice-president and director of advertising sales; A. R. Venezian vice-president and circulation coordinator; Daniel F. Crowley, vice-president and controller. OFFICERS OF THE CORPORATION: Donald C. McGraw, president; Hugh J. Kelly, Harry L. Waddell, executive vice-presidents; L. Keith Goodrich, executive vice-president and treasurer; John J. Cooke, vice-president and secretary.

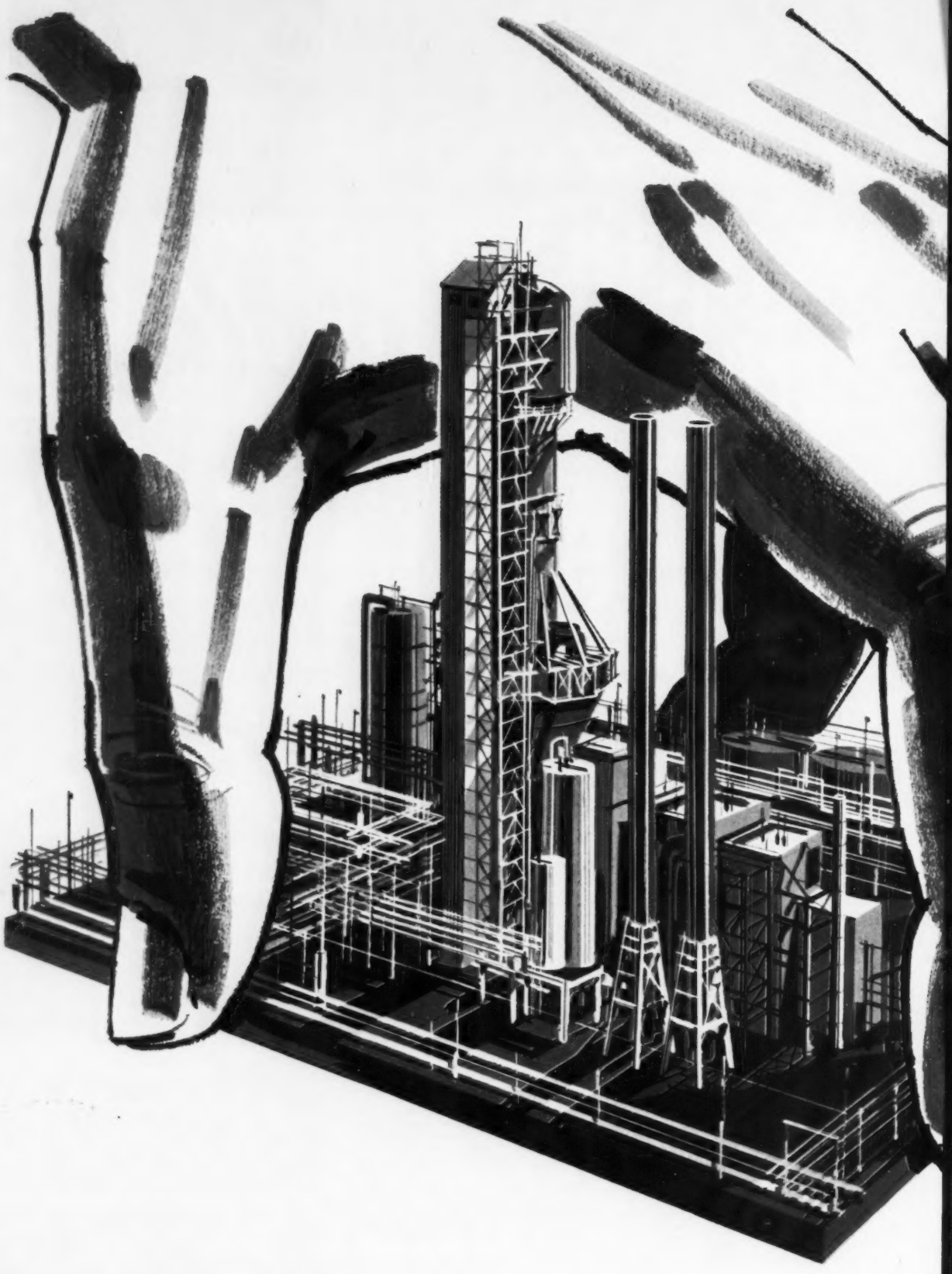
United States and United States possessions subscription rate for individuals in the field of the publication, $3 per year; single copies, 50¢. Foreign subscription rates per year: Canada, $4; other Western Hemisphere countries, $15; all others, $25, payable in advance. Printed in U.S.A. Title registered in U.S. Patent Office,

© Copyright 1961 by McGraw-Hill Publishing Co. Inc. All rights reserved. UNCONDITIONAL GUARANTEE: the publisher, upon direct request from any subscriber to our New York office, agrees to refund the part of the subscription price applying to copies not yet mailed. Our primary aim is to provide subscribers with a useful and reliable publication. Comments and suggestions for improvement are encouraged.

Chemical Week is available only by paid subscription. Subscriptions are solicited only from management men in the Chemical Process Industries in administration, production and plant operation, design and construction, research and development, and purchasing. Position, company connection and nature of company's business, products and approximate number of employees must be indicated on subscription application. Send to address shown below. Publisher reserves the right to refuse nonqualified subscriptions.

SEND SUBSCRIPTION CORRESPONDENCE AND CHANGE OF ADDRESS TO FULFILLMENT MANAGER, CHEMICAL WEEK, 330 WEST 42nd ST., NEW YORK 36, N. Y. SUBSCRIBERS SHOULD NOTIFY FULFILLMENT MANAGER PROMPTLY OF ANY CHANGE OF ADDRESS, GIVING OLD AS WELL AS NEW ADDRESS, AND INCLUDING POSTAL ZONE NUMBER, IF ANY. IF POSSIBLE, ENCLOSE AN ADDRESS LABEL FROM RECENT ISSUE OF CHEMICAL WEEK. PLEASE ALLOW ONE MONTH FOR CHANGE TO BECOME EFFECTIVE.

Postmaster: Please send Form 3579 to Fulfillment Manager, Chemical Week, 330 West 42nd St., New York 36, N.Y.



Foster Wheeler ***Heat Engineered*** **products, plants and processes...for the world's industrial progress.**

Experience engineers your plant and puts it where you want it

The ideal objective in planning your process installation is to arrive at the most direct and economical route to your production and quality requirements.

If anything can bring you close to this ideal, it is experience . . . and this is what Foster Wheeler has to offer . . . unusually broad experience in process design, engineering, procurement, construction and plant start-up. The adaptability of this experience has been demonstrated by over 800 successful major installations in 41 nations.

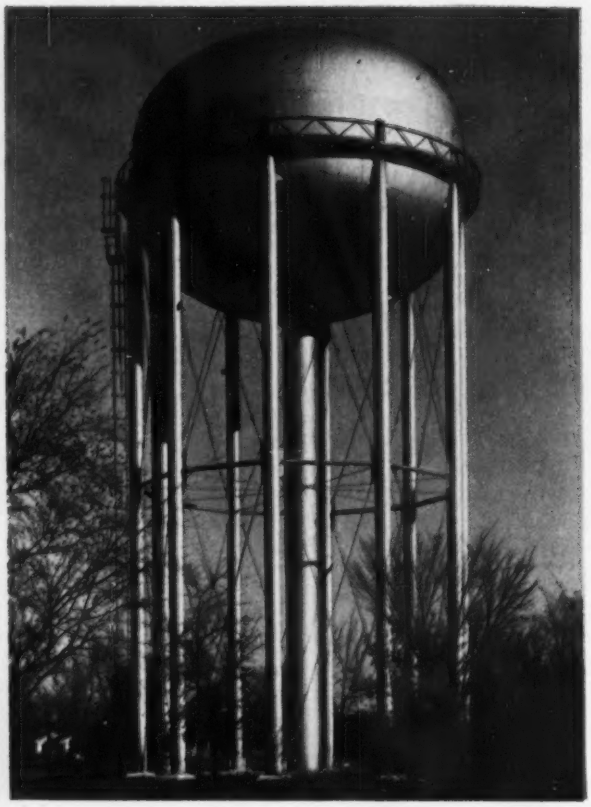
FW engineers have established their ability to meet guarantees for quality, cost and production. In addition, they have found and developed hidden opportunities in many processes for still greater cost reduction and for improved performance. If you are considering a new process installation, it will profit you to discuss your requirements with Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N.Y.

FOSTER WHEELER

NEW YORK TORONTO LONDON PARIS MILAN TOKYO

SILICONE NEWS from Dow Corning

Found: a paint that lasts



Silicone-based paints last longer; reduce maintenance time and costs

These two pictures emphasize the stubborn fight that maintenance coatings based on Dow Corning silicone resins put up against severe weathering conditions. Located in a northern industrial city, this water tower is constantly exposed to an army of paint killers — summer sun, winter sleet, smoke, rain, *plus* a corrosive chemical laden atmosphere.

At left, the tower is shown two years after it was painted with a conventional organic coating that withstood severe weathering during this period. Rust and corrosion marred its appearance and promised even greater damage. Using organic paints it was necessary to paint the tower at least every two years, a costly, almost continuous job.

Now, see how a silicone-based paint has cut this maintenance process in half. At the right, the tower is coated with an aluminum pigmented silicone-alkyd. But this paint job was done two years ago! The tower is still gleaming bright and completely protected. And maintenance men predict it will stay that way for several years more. The savings in time and money are obvious.

Beat high heat! Such a silicone-based coating can also be readily applied to surfaces that run hot, such as encountered on industrial stacks, mufflers, furnaces. Blistering, peeling, rust and corrosion are prevented; need for costly repainting and — in many cases — expensive replacement is greatly reduced.

Lasting colors, too. Silicone-based paints are now available in many colors . . . colors that stay put and don't fade. This means you can carry your color-coding on hot equipment for greater safety and efficiency while improving the overall beauty of your plant.

When you can have coatings like this — that last from 25% to 50% longer; that make plants and equipment look better, longer — don't you think you should find out more about them soon?

Send for your copy of "Why Silicone-Based Paints Mean Less Maintenance". Write Dow Corning Corporation, Department 2821, Midland, Mich.

first in silicones

Dow Corning

Chemical Week

Robert S. Muller ..... Publisher

Howard C. E. Johnson ..... Editor-in-Chief

Ralph R. Schulz ..... Managing Editor
Emil J. Mikity ..... Assistant Managing Editor
J. Robert Warren .... Assistant Managing Editor
Donald P. Burke ..... Associate Editor
Anthony J. Piombino ..... Associate Editor

DEPARTMENTS

Administration ..... Joseph F. Kalina, editor
James C. Smith
Business News ..... Homer Starr, editor
John W. Price Jr.
Engineering ..... Ryle Miller, editor
Foreign ..... Bruce Bendow, editor
Markets ..... Richard T. Ozimek, editor
Hans Weiss
Production ..... Herbert C. Short, editor
John P. Henry
Research ..... Philip A. Untersee, editor
Donald M. Levin
Sales ..... Charles Joslin, editor
Seth Goldstein
Specialties ..... Richard J. Callahan, editor
Reports ..... Jorma Hyypia, editor
Copy ..... William Mullinack, editor
Albert H. Kislin
Art ..... Robert T. Martinott, director
Richard Kluga; Forbes Linkhorn
Dolores Able
Buyers' Guide ..... Betsy L. Emery, editor
Patricia Middleton

REGIONAL EDITORS

Chicago ..... John M. Winton, editor
Nina Seawick
Houston ..... Thomas H. Arnold, editor
Wilma Cortines
San Francisco ..... Martin D. Robbins, editor
Maria Theresa Shaw

NATIONAL AND WORLD NEWS

Economics ..... Douglas Greenwald
News Bureaus ..... John Wilhelm, Director
Margaret Ralston, Managing Editor

Domestic

Atlanta, B. E. Barnes; Chicago, Stewart Ramsey; Cleveland, Arthur Zimmerman; Dallas, Marvin Reid; Detroit, Donald MacDonald; Los Angeles, Kemp Anderson, Jr.; San Francisco, Jenness Keene; Seattle, Ray Bloomberg; Washington, George B. Bryant, Jr. Correspondents in 81 principal cities of the United States.

Foreign

Bonn, Peter Forbath; London, John Shinn; Mexico City, John Pearson; Milan, Gene DiRaimondo; Moscow, Ernest Conine; Paris, Robert Farrell; Rio de Janeiro, Leslie Warren; Tokyo, Sol Sanders. Correspondents in 78 cities.

Knox Armstrong .... Advertising Sales Manager
Alvin J. Babkow ..... Business Manager
Fred E. Lesner ..... Sales Promotion Manager
John M. Pierce ..... Market Service Manager
Robert L. Maier ..... Advertising Makeup
Paul W. Erb ..... Circulation Manager
Frances Regan ..... Reprints
Advertising Salesmen ..... See Adv. Index

Diperoxide Patent

TO THE EDITOR: The recent article (*July 22, p. 39*) on "New organic diperoxides" for crosslinking polyethylene and other uses, makes reference throughout to the product, 2,5 - bis(tert-butylperoxy) - 2,5-dimethylhexane, as Lucidol's 101. The emphasis on this particular tradename does not take into account the strong activity of FMC Corp. in this field, as evidenced by the issuance to E. R. Gilmont of FMC on Dec. 8, '59, U.S. Patent No. 2,916,481, the first and only patent to date on the use of this peroxide. Your description of the commercialization of a crosslinked carbon black-filled polyethylene for wire insulation by the Cabot Corp. illustrates one of the uses specifically covered by the Gilmont patent.

The statement that these new products are now "leaving the research labs" overlooks the fact that FMC has been manufacturing this peroxide since early '59. It has been distributed since that time under the tradename Varox by the R. T. Vanderbilt Co. (whom you had listed as the manufacturer).

It is misleading and inaccurate to refer to these diperoxides as being "complex mixtures of chemicals, and like all peroxides, dangerous to handle." The peroxide mentioned above is not a mixture; it is, in fact, a pure chemical of well-defined structure. While it is certainly recognized that some organic peroxides are hazardous, this product is very stable and very easy to handle.

ERNEST R. GILMONT
FMC Corp.
Inorganic Chemicals
Research and Development Dept.
Princeton, N. J.

Explosive-Forming

TO THE EDITOR: We noted with interest your article, "Explosive-Forming Shapes a New Market" (*July 8, p. 93*). I think your coverage of this technique was very well handled. Explosive forming, as you indicate, is not a panacea for all forming jobs but certainly hold great promise.

Most of the work on this technique has been in areas of shaping large pieces and in explosive compacting. . . . This need not to be a limitation on the use of this technique, but rather one of several avenues which might be followed.

A miniature charge recently developed by Amcel illustrates this point. The problem was presented to Amcel by Pratt & Whitney Aircraft's Research and Development Center in West Palm Beach, Fla. The requirement called for a small metal tube, cylindrical on one end but square on the other. It was specified that the square end have very sharp corners. Explosive forming seemed a practical and efficient method of meeting the requirements.

The size of the original tube was less than ½ in. in diameter with a wall thickness of about .015 in. It was imperative that there be no metal particles associated with the charge that would affect the uniformity of wall thickness of the tube.

Amcel developed a small, nylon plastic-encased charge, ¼ in. OD and slightly over 1½ in. long. The charge, designated Formex-I, contained only a very small amount of explosive and was ignited by a bridgewire. This tiny charge effectively shaped the tube against the walls of a steel die. The finished part met the specifications. It also achieved sharper corners than could normally be expected from conventional methods of manufacture. . . .

F. ROBERT MAYER
Amcel Propulsion Inc.
Asheville, N. C.

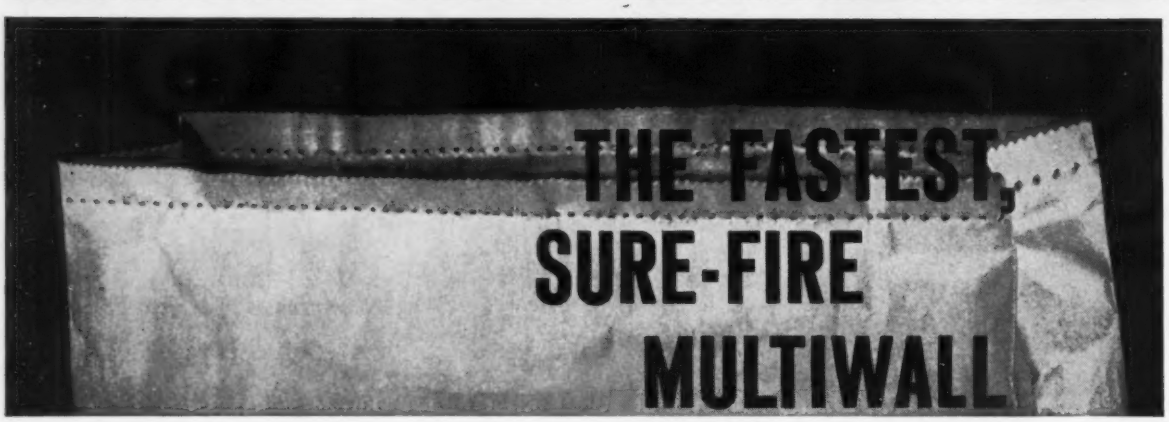
Fumaric Capacity

TO THE EDITOR: The capacity of Bzura's fumaric acid plant (*CW, Aug. 26, p. 64*) [is incorrectly quoted]. You will note in the attached prospectus for the Securities Exchange Commission that the capacity is approximately 15 milion lbs./year of fumaric acid.

HYMAN BZURA
President
Bzura Chemical Co., Inc.
Keyport, N. J.

GE's Polyethylene Patents

TO THE EDITOR: Your excellent article, New Pay-Off in Peroxide Research (*July 22, p. 39*), failed to cover an important aspect of the subject which may be of interest to your readers.



*Trade Mark

OPENING

How fast can you swing your arm?

That's how fast you can open a Bemis Multiwall with Bemi-Strip closure. Just grab the red tab and pull. The bag opens quickly, easily.

A tight seal . . . yet a fast, economical opening that leaves the bag intact.

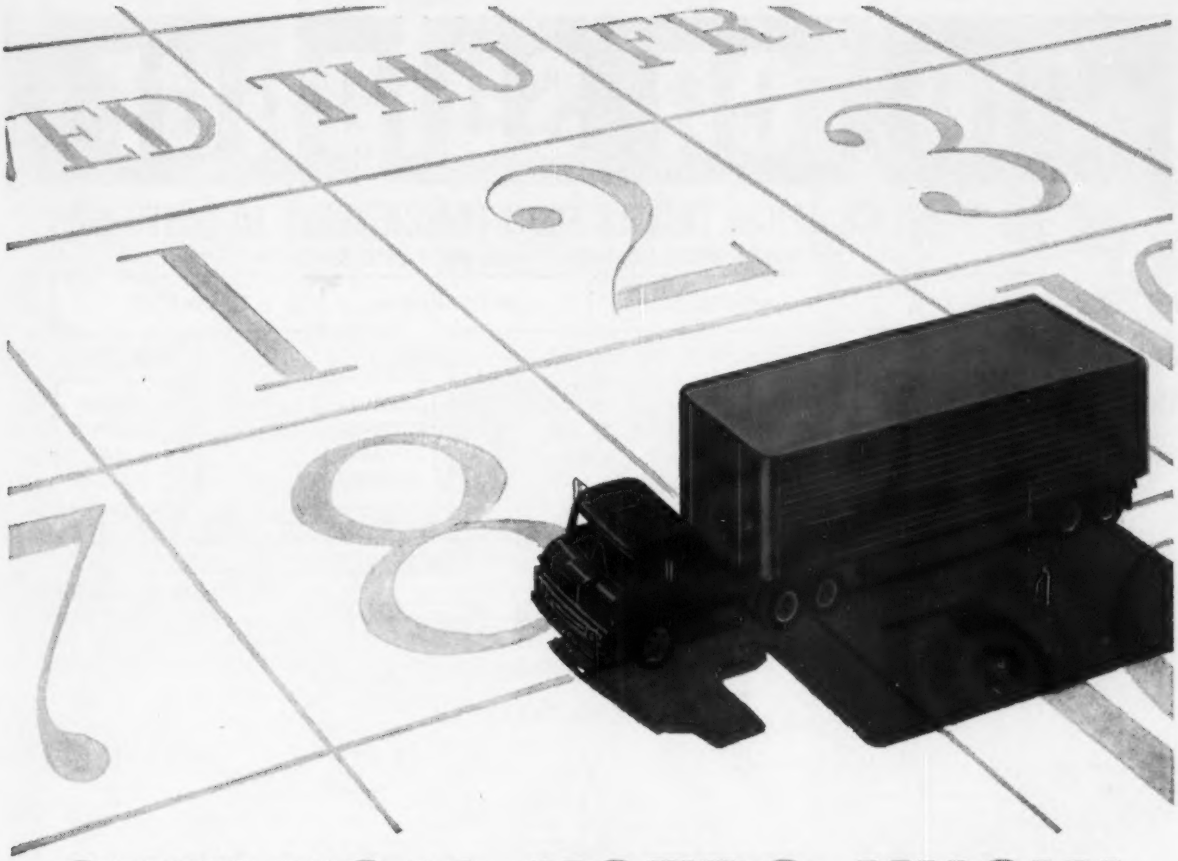
No fumbling for thread ends. No cutting. No stuck closure seams. And no paper shreds or thread clippings, so . . . assured cleanliness.

Ask your Bemis man for complete information.

BEMIS BRO. BAG CO.

where packaging ideas are born

General Offices—408-J Pine St., St. Louis 2 • Sales Offices in Principal Cities



CHEMICAL USERS KNOW

what a difference a day makes

SAME-DAY SHIPMENTS CUT DOWN INVENTORIES AND PRODUCTION COSTS. And that's particularly true when you buy processing chemicals. Even a day's delay of a critical chemical can play havoc with production schedules. Yet big inventories tie up space and capital.

SAME-DAY SHIPMENTS SOLVE BOTH PROBLEMS. Here at J. T. Baker we ship more than 90% of all orders the *same day* they're received. We keep our inventories high so *you* can keep yours low. You get speedy, dependable, on-schedule deliveries from either Phillipsburg, New Jersey or Chicago, Illinois.

CONTROL OF VARIABLES. J. T. Baker industrial chemicals are manufactured to extremely high, defined standards of purity and uniformity to control costly variables in your processing. In industry after industry, Baker Processing Chemicals provide the key to faster, more efficient processing—yet they are competitively priced.

Control of variables . . . same-day shipments. Surely two good profit-making reasons to discuss your requirements with J. T. Baker Chemical Co., Phillipsburg, New Jersey.

A PURCHASING AGENT BUYS MANY VALUES TO PLEASE MANY MEN

. . . he knows that bidding to specification is only one measurement—he analyzes all of the values. For example—the value of *speedy deliveries* for his Production Manager. For his Plant Superintendent, consistently high quality means fewer processing variables and trouble-free operation. Which values help the Quality Control Chief? The Chemical Engineer? The Cost Accountant?

The Purchasing Agent knows! He's the nerve center—the focal point—the essential Man in the Middle.

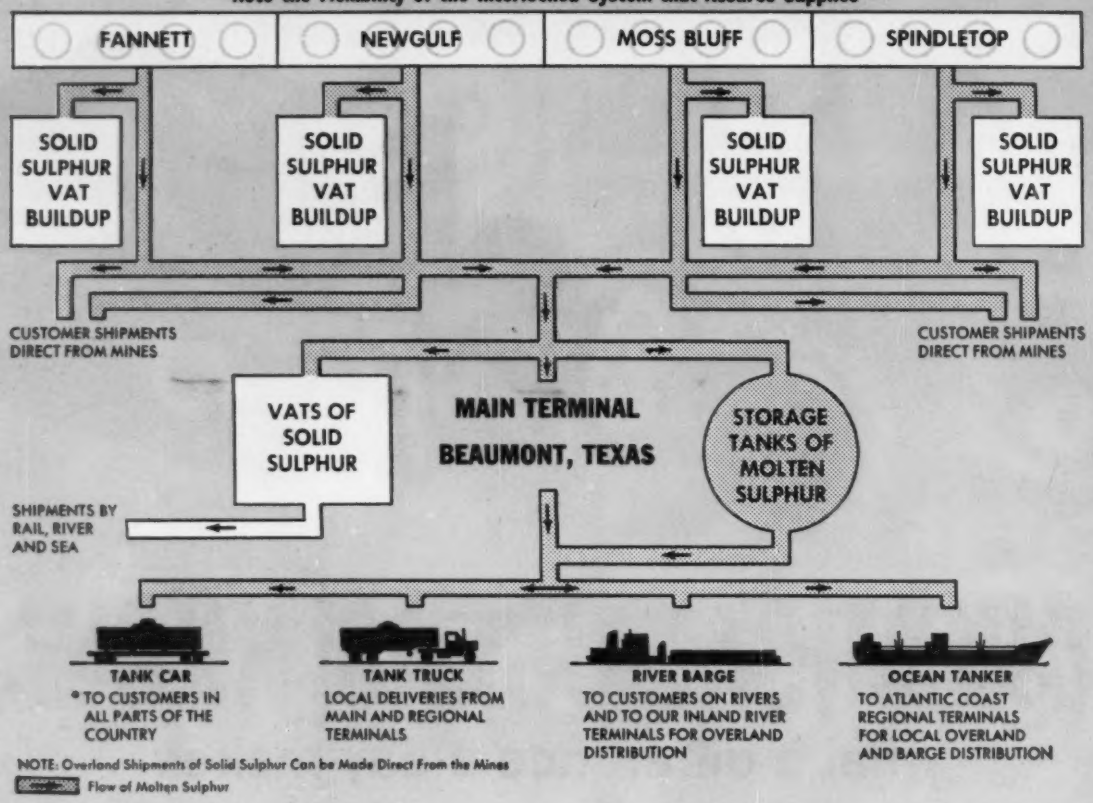
J.T.Baker CHEMICAL

J. T. Baker Production Chemicals

molten sulphur

HOW TGS MOLTEN SULPHUR TRAVELS FROM FRASCH MINES TO CUSTOMERS

—Note the Flexibility of the Interlocked System that Assures Supplies—


FANNETT
NEWGULF
MOSS BLUFF
SPINDLETOP
SOLID SULPHUR VAT BUILDUP
SOLID SULPHUR VAT BUILDUP
SOLID SULPHUR VAT BUILDUP
SOLID SULPHUR VAT BUILDUP
CUSTOMER SHIPMENTS DIRECT FROM MINES
CUSTOMER SHIPMENTS DIRECT FROM MINES
VATS OF SOLID SULPHUR
MAIN TERMINAL
BEAUMONT, TEXAS
STORAGE TANKS OF MOLTEN SULPHUR
SHIPMENTS BY RAIL, RIVER AND SEA
TANK CAR
* TO CUSTOMERS IN ALL PARTS OF THE COUNTRY
TANK TRUCK
LOCAL DELIVERIES FROM MAIN AND REGIONAL TERMINALS
RIVER BARGE
TO CUSTOMERS ON RIVERS AND TO OUR INLAND RIVER TERMINALS FOR OVERLAND DISTRIBUTION
OCEAN TANKER
TO ATLANTIC COAST REGIONAL TERMINALS FOR LOCAL OVERLAND AND BARGE DISTRIBUTION
NOTE: Overland Shipments of Solid Sulphur Can be Made Direct From the Mines
Flow of Molten Sulphur

Flexible Facilities to meet a Growing Demand

The rapidly growing demand for deliveries of sulphur in molten form—and it is coming from all parts of the country—is well-answered by the flexibility of our production, storage and distribution facilities.

Here, graphically, is the way TGS Molten Sulphur moves from the four Frasch Process producing areas in Texas to customers. Unusual flexibility enables us to do several things simultaneously. We can fill orders direct from the mines, build up inventory at our main terminal in Beaumont, Texas, ship to customers from this main terminal or supply our regional terminals.

We maintain steady production schedules at all properties. With flexible storage, shipping and delivery facilities of not only molten sulphur but solid sulphur, we are in a strong position to serve the sulphur-consuming plants all over the United States and Canada. Our sulphur recovery plants (from natural gas) in Wyoming and Alberta take care of the demand in northwest United States and Western Canada for both molten and solid sulphur.

TEXAS GULF SULPHUR COMPANY
75 East 45th Street, New York 17, N. Y.
811 Rusk Avenue, Houston 2, Texas
Sulphur Producing Units: Newgulf, Texas • Moss Bluff, Texas • Fannett, Texas • Spindletop, Texas • Worland, Wyoming • Okotoks, Alberta, Canada

As a result of the early and significant contributions made by the General Electric Research Laboratory in the peroxide cross-linking of polyethylene, Precopio and Gilbert patent 2,888,424 [was assigned] to General Electric Co. on May 26, '59, with claims covering polyethylene compounded with a variety of fillers and cross-linked with various peroxides, including diperoxides.

GE has granted and is offering to grant nonexclusive licenses under this patent to domestic manufacturers for filled chemically cross-linked polyethylene. Through an agreement with Hercules Powder Co., rights under Ivett patent 2,826,570 directed to unfilled chemically cross-linked polyethylene are included in the GE licenses.

GE research in peroxides has continued for a number of years and the company presently has pending a number of patent applications directed to various aspects of peroxide development.

J. T. CASTLES
General Manager
General Electric Co.
Pittsfield, Mass.

"Missionary Society"

TO THE EDITOR: With regard to M. Frank Levy's letter . . . (*July 22, p. 7*), it occurs to me that the gentleman from New York has confused the chemical industry with some sort of missionary society.

We may think what we like, but the main purpose of a corporation is to return a fair profit to its stockholders by producing a quality product at the right price. In a competitive society, plants must be located with a regard for transportation, natural resources, tax exemptions, availability of labor, etc. [For a corporation] to do otherwise is to remove itself from a highly competitive market. If you doubt the hard and probably cold logic of this, try cutting a stockholder's profits and tell him it went for a moral cause.

The South has had enough outside criticism. The laws have been written and are clear. Now it must do its own moral housecleaning. To me it is sheer fantasy to consider embroiling the chemical industry in a specific moral problem. Please leave enforcement of justice to the Justice Dept. and forget economic blackmail.

Progress, like justice, is often slow and sometimes cruel in its slowness, but both will be served.

EDWARD A. CHRISTOPHER
Louisville, Ky.

CW welcomes expressions of opinion from readers. The only requirements: that they be pertinent, as brief as possible.

Address all correspondence to: H. C. E. Johnson, Chemical Week, 330 W. 42nd St., New York 36, N.Y.

Perlite Pioneer

TO THE EDITOR: The article on filter aid growth (*Aug. 12, p. 33*) has been read with considerable interest. . . .

Very little mention is given the Sil-Flo Corp., but it is common knowledge in the industry that our company was responsible for the development and initial market introduction of this new-type filtering earth. In fact, these efforts were strongly opposed by the two major diatomaceous earth producers at numerous freight rate hearings throughout the country. Their efforts were directed at keeping perlite at a disadvantage, freightwise, with diatomaceous earth filter aids shipped from their California plants. Where the article mentions "the perlite filter aid market almost died aborning," this is true, but is due to the efforts of diatomaceous earth suppliers to keep perlite noncompetitive.

Regarding the estimated output of the various companies, in our opinion the tonnage figures should be revised. We do not have access to production figures for all of those listed, but are in close contact with the filter aid market, and know where perlite materials are in use, and who supplies them. We do know that Sil-Flo shipments total a far greater tonnage than your article states. . . .

The publicity given the growth of perlite filter aids is appreciated by all in the industry; however, we trust you will correct the impression as to who is actually responsible for the pioneering and development of this new product. . . .

W. T. SNIPES
President
Sil-Flo Corp.
Fort Worth, Tex.

can be costly! On conveyors, a new type of lubricant developed by Cowles helps bottlers beat breakage. It is new ideas like this that produce an ever-widening market for Cowles organic and inorganic processing chemicals. For new things in chemical know-how, keep your eye on Cowles.

NEW PRODUCTS
NEW FACILITIES
NEW THINKING

Cowles

COWLES CHEMICAL COMPANY
Cleveland 20, Ohio

FOR DANGEROUS MATERIALS .... Republic's Heavy Duty Drums offer proven reliability. Sizes, gages, heads, hoops, threaded openings, and finishes (paint, galvanizing, or tinning) to meet ICC-5, 5A, 5B, 5C, 5K, 6A, 6B & 17F specifications. Republic also offers stainless drums for top chemical resistance, longer service life.

Call your Republic Container salesman

REPUBLIC STEEL

CONTAINER DIVISION

465 Walnut Street • Niles, Ohio

New York Offices: 30 Church Street, New York 7, New York

This STEELMARK of the American Steel Industry tells you a product is made of Steel. Look for it when you buy.

MEETINGS

International Superphosphate Manufacturers' Assn., technical conference, Wiesbaden, Germany, Sept. '61.

Chemical Market Research Assn. meeting, Lake George Sagamore Hotel, Bolton Landing, N.Y., Sept. 10-12.

American Mining Congress, metal mining-industrial minerals convention, Seattle, Wash., Sept. 11-13.

National Industrial Conference Board, international industrial conference, Fairmont Hotel, San Francisco, Sept. 11-15.

Instrument Society of America, 16th annual instrument-automation conference and exhibit, Memorial Sports Arena, Los Angeles, Sept. 11-15.

Southeastern Plant Engineering and Maintenance Seminar, third annual, Town Hall, Greensboro, N.C., Sept. 12-14.

Conference on new-product development in the field of high-polymer coatings, Engineering Extension at the University of California, UCLA campus, Sept. 12-15.

National Petroleum Refiners Assn., fall meeting, Hotel Traymore, Atlantic City, N.J., Sept. 13-15.

Wright-Patterson AFB, Ohio, Technical Symposium, Aeronautical Systems Division of the Air Force Systems Command, Phoenix, Ariz., Sept. 13-15.

Armed Forces Chemical Assn., 16th annual meeting, Statler-Hilton Hotel, Washington, D.C., Sept. 13-15.

Drug, Chemical and Allied Trades Assn., 71st annual meeting, Pocono Manor Inn, Pocono Manor, Pa., Sept. 14-17.

Natural Gas Processors Assn., Rocky Mountain regional meeting, Northern Hotel, Bllings, Mont., Sept. 14.

American Society of Mechanical Engineers, joint engineering management conference, Roosevelt Hotel, New York City, Spt. 14-15.

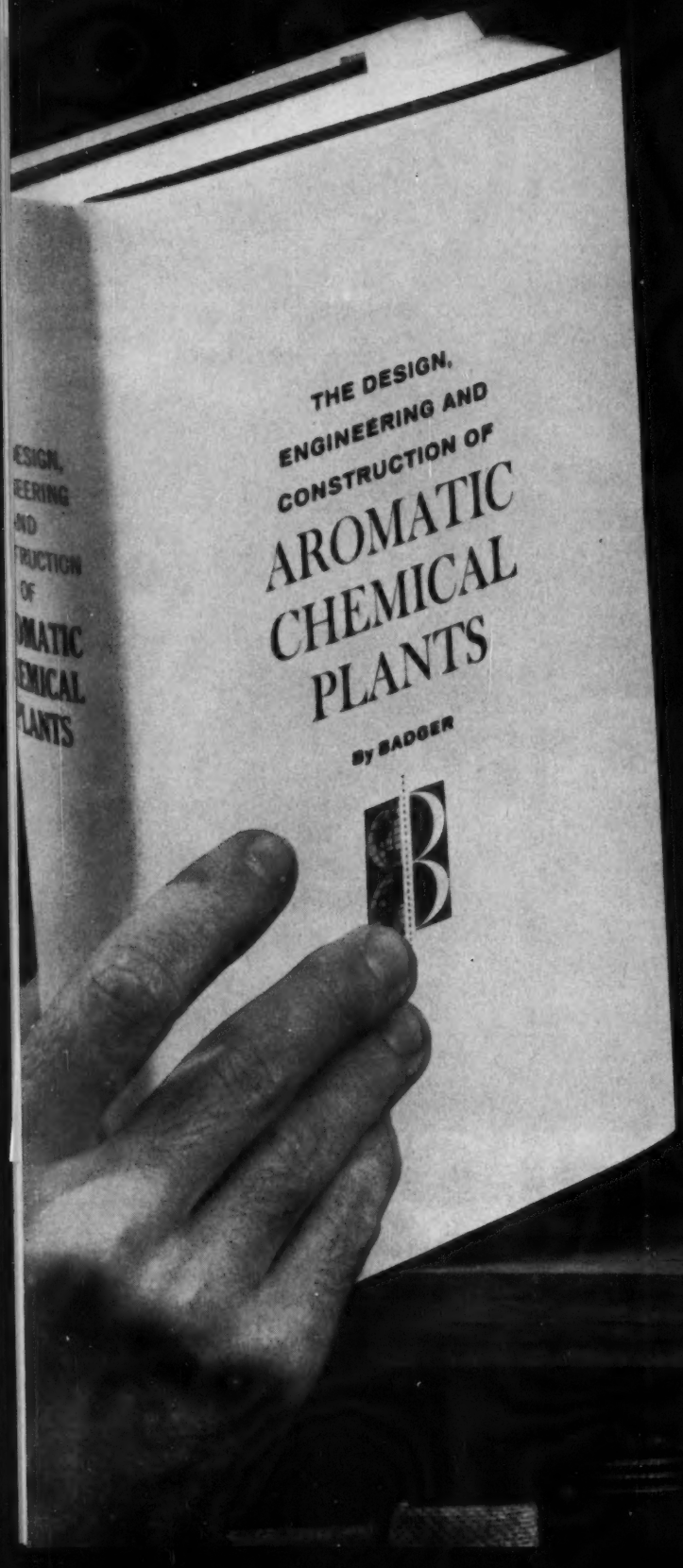
Technical Assn. of the Pulp and Paper Industry, third Evolutionary Operation (EVOP) course, Schine Inn, Chicopee, Mass., Sept. 15-16.

Canadian Agricultural Chemicals Assn., ninth annual meeting and conference, Mont Tremblant Lodge, Mont Tremblant, Que., Sept. 18-20.

Technical Assn. of the Pulp and Paper Industry, fourth international mechanical pulping conference, Edgewater Beach Hotel, Chicago, Sept. 19-21.

National Petroleum Refiners Assn., Rocky Mountain regional meeting, Henning Hotel, Casper, Wyo., Sept. 20-21.

Air Pollution Control Assn., 1961 annual meeting, East Central section, Sheraton-Seelbach Hotel, Louisville, Ky., Sept. 21-22.



ONLY BADGER COULD WRITE THE AUTHORITATIVE TEXT

Since 1952 Badger has designed, engineered and constructed thirty-eight plants for the production of aromatic chemicals. Their total worth exceeds $70 million; plants range in value from $.3 million to $10 million.

These impressive figures tell only some of the reasons why Badger could "write the book" on aromatics — whether it involves the production of crude products . . . their purification . . . or their conversion into other organic products. Without exception the plants demonstrate the exceptional creativity which is an important part of the stock in trade at Badger. In fact, many of them owe their existence to totally new — in some cases revolutionary — design and engineering ideas. Others, based on more classical engineering concepts, could have been routine plants producing routine products at routine costs. That they are not is again due to the full measure of creativity Badger has brought to their detailed engineering and construction.

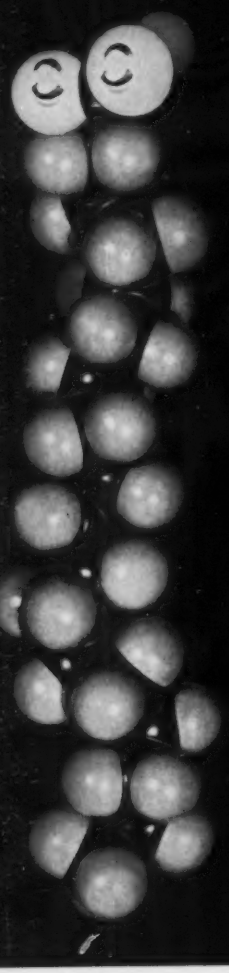
When you are considering new facilities for the production of any aromatic, talk first to the people who have made a habit of success in the field. Ask the Badger man for the full story — write, wire or phone today.

built by

BADGER

INTERNATIONAL DESIGNERS
ENGINEERS · CONSTRUCTORS

CAMBRIDGE • NEW YORK • HOUSTON • TORONTO
THE HAGUE • LONDON • BRUSSELS • PARIS • GENEVA



Emersol® Stearic Acids

Oxygen, as you know, is one of the friendlier elements. But there are times when a more stand-offish attitude would be appreciated... especially when close association with it yellows your product, ruins its consistency and turns it rancid.

Emersol 132 (triple-pressed grade) and Emersol 120 (double-pressed grade) are what you might call "oxygen snobs." With the steadfastness of a Puritan, they firmly resist oxygen's approaches.

This straight-laced character of Emersol Stearic Acids is your comforting assurance that your products will retain their delicate, pleasing color through

.....refuse to fraternize with Oxygen

(and you benefit)

processing, storage and use—that their texture will remain smooth and appealing—and that they will not develop rancidity.

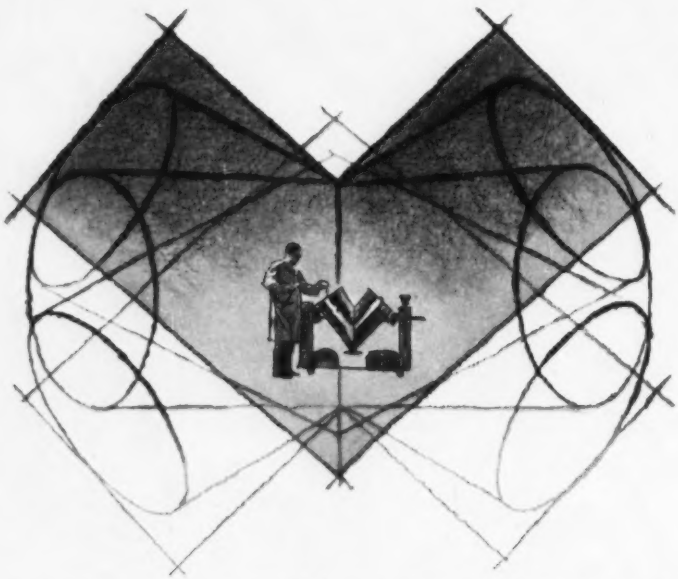
In addition to their remarkable resistance to oxidation, Emersol 132 and 120 offer clear-cut advantages in color, color stability and uniformity. In fact —a little extra everything except price.

We invite you to prove these statements to your own satisfaction in *your* products. Request an evaluation sample and ask for our 24-page Emeryfacts "Emersol Stearic Acids." Write Dept. I-9.

Emery FATTY ACID DIVISION

Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio
Vopcolene Division, Los Angeles, California • Export Division, Cincinnati, Ohio
Emery Industries (Canada) Ltd., London, Ontario

P-K Pre-Test Laboratory **uncovers new economies in solids processing** The unexpected often happens at the P-K Pre-Test Laboratory. Extraordinary opportunities for savings in time, space, materials, manpower and equipment come to light. Here, under your guidance and using your materials, P-K engineers demonstrate revolutionary equipment that blends liquids and solids, granulates, vacuum dries, coats, reacts chemicals, sterilizes – telescopes as many as ten conventional multi-step operations into a single unit. » » » The

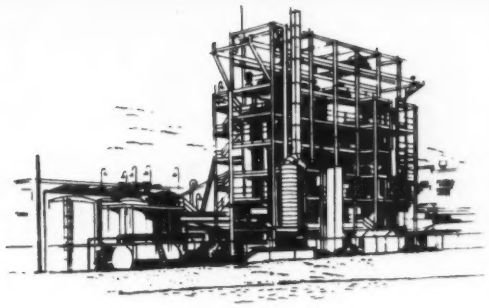


P-K Pre-Test Laboratory works out subtle variations in solids processing. It simplifies operational procedures, provides scale-up data, accurately predicts economies. It features a pilot model of the new P-K Solids Processor*. Also available are standard, intensifier and liquid-solids Twin Shell* Blenders and vacuum tumble dryers, double cone blenders and ribbon blenders. » » » This unique laboratory – plus the experience of engineers who have run thousands of resultful pre-tests—is available to you without cost or obligation. Why not explore the possibilities of improving your current processing methods? Write or dial George Sweitzer direct (717-HA 1-7500) for particulars and a preliminary evaluation. Also ask for our new process equipment catalog No. 16-P. *patented

patterson-kelley
Chemical and Process Equipment Division
157 Burson Street, East Stroudsburg, Pa.

organic chemicals

FROM ROHM & HAAS COMPANY



ACRYLIC MONOMERS

Acrylic Esters

Acrylates $CH_2 = CHCOOR$

Methacrylates $CH_2 = C(CH_3)COOR$

Polymers derived from this series of acrylic and methacrylic esters vary from soft, elastomeric, film-forming materials to hard plastics. These esters may be polymerized by bulk, suspension, solvent, and emulsion techniques. They copolymerize with a large number of other monomers and can contribute to copolymer systems: internal plasticization, increased polymerization rate, greater toughness, improved compatibility with other resins, better adhesion, improved dyeability, and better resistance to heat, light, and weathering. *Typical uses:* plastic sheets and molding powders, latex paints, other emulsion and solution coatings, adhesives, textile finishes, paper coatings, leather finishes, water-soluble thickeners, floor polishes, heat-resistant elastomers, surfactants, and dispersants. *Commercially available.*

- Methyl Acrylate
- Ethyl Acrylate
- Butyl Acrylate
- 2-Ethylhexyl Acrylate
- Methyl Methacrylate
- Ethyl Methacrylate
- Butyl Methacrylate
- Hexyl Methacrylate
- Decyl-Octyl Methacrylate
- Lauryl Methacrylate
- Stearyl Methacrylate

Acrylic Acids

$CH_2 = CHCOOH$
Glacial Acrylic Acid

$CH_2 = C(CH_3) - COOH$
Glacial Methacrylic Acid

Glacial methacrylic acid and *glacial acrylic acid* can be polymerized to water-soluble polymers. They also copolymerize with many other monomers and provide means for introducing carboxyl groups into copolymers. In copolymers, these acids can: 1) improve adhesion properties, 2) improve freeze-thaw and mechanical stability of polymer dispersions, 3) provide solubility in alkalies, including ammonia, 4) increase resistance to attack by oils, and 5) provide reactive centers for crosslinking by divalent metal salts, diamines, or epoxides. *Commercially available.*

Functional Group Methacrylate Monomers

Dimethylaminoethyl methacrylate and *t-butylaminoethyl methacrylate* offer means for introducing into copolymers pendant amino groups which can promote adhesion to many substrates and provide anchoring sites for dyes and pigments. The amino groups can also serve as reactive sites for secondary crosslinking. Dimethylaminoethyl methacrylate or t-butylaminoethyl methacrylate can be copolymerized with water-insoluble monomers to give water-soluble copolymers. Acid-soluble copolymers can be obtained by incorporation of even small amounts of these monomers in the polymer. Application possibilities: binders for coatings, textile chemicals, dispersing agents for non-aqueous systems, antistatic

$CH_2 = C(CH_3) - COCH_2CH_2N(CH_3)_2$
Dimethylaminoethyl Methacrylate

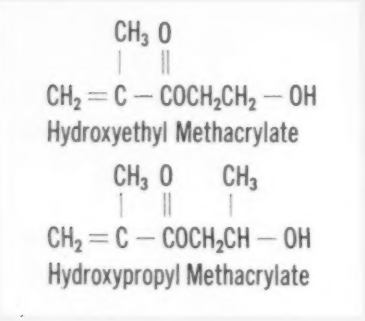
$CH_2 = C(CH_3) - COCH_2CH_2NH\,C(CH_3)_3$
t-Butylaminoethyl Methacrylate

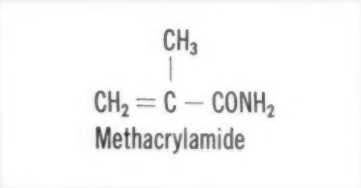
continued.....

Functional Group Methacrylate Monomers (continued)

agents, stabilizers for chlorinated polymers, ion exchange resins, emulsifying agents, cationic precipitating agents. *Commercially available.*

Hydroxyethyl methacrylate and *hydroxypropyl methacrylate* permit the introduction of reactive hydroxyl groups into copolymers —and thus offer possibilities for subsequent crosslinking and for increased adhesion to selected substrates. Potential applications include binders for nonwoven fabrics, wool stabilization formulations, and coatings—particularly thermosetting types. *Available in development quantities.*

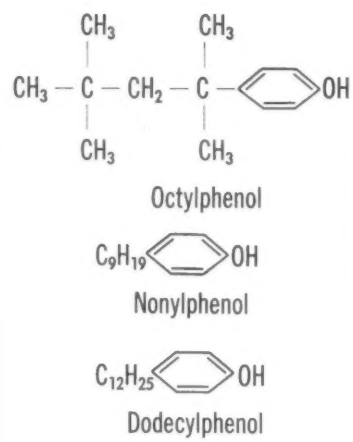




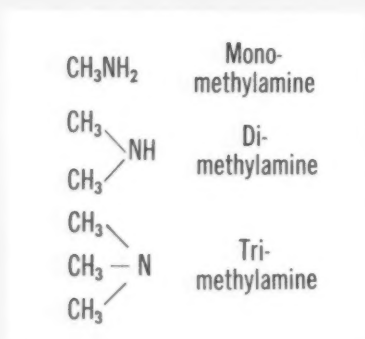
Methacrylamide can be polymerized to a water-soluble polyamide. When polymerized at elevated temperatures, it gives a water-insoluble polymer containing imide groups. It also copolymerizes with other monomers to give reactive sites for crosslinking. Many useful products are formed when methacrylamide or its polymers and copolymers are reacted with formaldehyde. Suggested applications: polymers for textile, leather, and paper finishing; dispersing agents; thickening agents; adhesives. *Methacrylamide is available in development quantities.*

ALKYLPHENOLS

Octylphenol is a flaked solid; nonylphenol and dodecylphenol are liquids. They undergo the normal reactions of the phenolic hydroxy group and nuclear substitution of the benzene ring. Reactions include etherification, condensation with aldehydes, esterification, sulfonation, halogenation, and nitration. Etherification of alkylphenols with ethylene oxide produces a variety of surface-active agents. Lubricating- and fuel-oil additives and vinyl stabilizers are obtained from calcium and barium salts of alkylphenol derivatives. Phenolic resins with improved oil-solubility, water resistance, and electrical resistance are produced by condensing formaldehyde with phenol and a small quantity of an alkylphenol. Octylphenol stabilizes ethyl cellulose against ultraviolet light degradation. Alkylphenols also offer possibilities in preparing fungicides, bactericides, dyestuffs, pharmaceuticals, adhesives, and rubber chemicals. *Commercially available.*



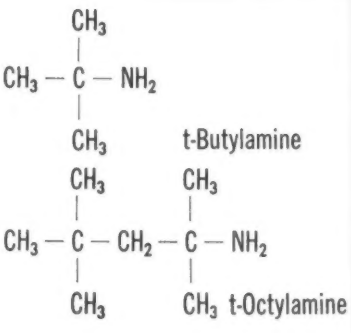
METHYLAMINES



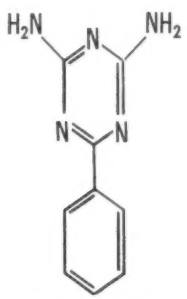
Mono-, di- and trimethylamine—low-cost sources of amino nitrogen —are useful for preparing: dimethylformamide, dimethylacetamide, and N-methyl-2-pyrrolidone for use as solvents; rubber accelerators and short stops of the thiuram and carbamate types; insecticides; fungicides; herbicides; unsymmetrical dimethylhydrazine, a rocket fuel; sarcosines and N-methyltaurine for surfactants; p-methylaminophenol, a photographic developer; choline chloride for poultry and animal feeds; high-molecular-weight quaternary ammonium salts for use as bactericides, textile softeners, and surfactants; quaternary ammonium type anion exchange resins; theophylline, caffeine, antihistamines, and other pharmaceuticals. *Commercially available in aqueous and anhydrous forms.*

t-ALKYL AMINES

t-Butylamine, t-octylamine, PRIMENE 81-R and PRIMENE JM-T have a number of unusual properties not shown by straight-chain amines of corresponding molecular weight. Some are: fluid character and low viscosity over a wide temperature range, color stability, resistance to oxidation, and excellent oil solubility. Although t-alkyl amines undergo most of the reactions common to their straight-chain isomers, the attachment of the amino group to a tertiary carbon imparts unusual reactivity to t-alkyl amines in several reactions—e.g. formation of principally secondary amines in alkylation reactions, and the formation of stable aldimines (RN=CHR′), carbodiimides (RN=C=NR), and t-alkyl cyanamides (RNH—CN). The last three derivatives of normal primary amines are relatively unstable. *Typical uses:* intermediates for surfactants, corrosion inhibitors, pharmaceuticals, rubber chemicals, insecticides, bactericides, dyes, antistatic agents, textile chemicals, oil additives. *Commercially available.*

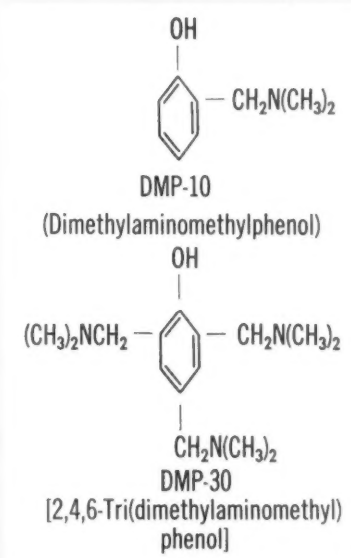


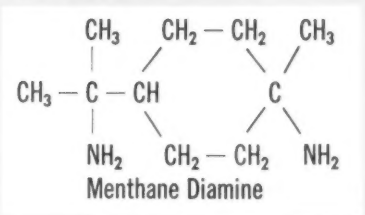
OTHER AMINES



Benzoguanamine, a substituted triazine, reacts with formaldehyde to give thermosetting resins with heat resistance, alkali resistance, and gloss properties generally superior to those of melamine-formaldehyde resins. Benzoguanamine resins are useful for protective coatings, paper additives and finishes, laminating agents, textile finishes, and adhesives. In addition, benzoguanamine undergoes many other useful reactions, and offers promise as an intermediate for making insecticides, fungicides, plasticizers, pharmaceuticals, and polycarboxylic acids for preparing alkyd resins. *Commercially available.*

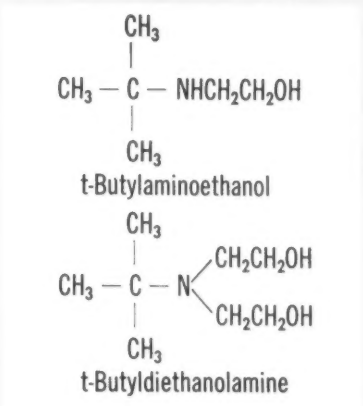
The *dimethylaminomethylphenols, DMP-10* and *DMP-30*, are Mannich-type bases useful as antioxidants, acid neutralizers, stabilizers, and catalysts for epoxide and polyurethane resins. *Commercially available.*





Menthane diamine is a primary alicyclic diamine. Like the other t-alkyl amines, it has its amino groups attached to ternary carbons and thus exhibits steric-controlled reactivity. *Suggested uses:* curing agent for epoxy resins and intermediate for preparing polyamides and menthane diisocyanate. *Commercially available.*

t-Butylaminoethanol and *t-butyldiethanolamine* offer possibilities for improving dye receptivity and adhesion in polyesters and polyethers. t-Butyldiethanolamine could be considered for polyester or polyether development as an integral component of the polymer. t-Butylaminoethanol might be used for end group modification of similar polymers. Suggested uses



organic chemicals FROM ROHM & HAAS

Other Amines (continued)

include: improving dye receptivity of polyester fibers, and preparation of alkyds containing internal quaternary groups. *Available in development quantities.*

Tetramethylethylene diamine is an excellent and economical catalyst for rigid and flexible polyurethane foams, and polyurethane elastomers and coatings. It also has value as an intermediate in the synthesis of quaternary ammonium compounds used for applications such as ion exchange resins, textile treating agents, and bactericides. *Commercially available in 70% aqueous solution and in 100% anhydrous form.*

$(CH_3)_2NCH_2CH_2N(CH_3)_2$

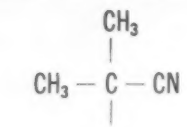
Tetramethylethylene Diamine

DYTOL Fatty Alcohols

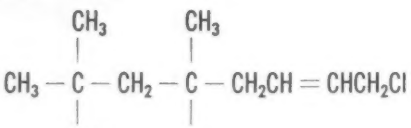
The DYTOL fatty alcohols have the general formula $CH_3(CH_2)_nOH$. Compositions are given in the table below. These fatty alcohols undergo many typical alcohol reactions. They may be ethoxylated, sulfated, esterified, halogenated, and dehydrated. They may be oxidized to aldehydes and carboxylic acids. *Typical uses:* Antifoaming and emulsifying agents. As chemical intermediates, DYTOL fatty alcohols are useful in making cosmetic-cream additives, polymerization regulators for rubber and plastics, textile finishing and softening agents, emulsifiers, lubricating-oil detergents, and quaternary ammonium compounds. *Commercially available.*

DYTOL	Principal Alcohol Component	Typical Alcohol Composition (% by Volume)					
		C_8	C_{10}	C_{12}	C_{14}	C_{16}	C_{18}
DYTOL M-83	Octyl, C_8	99.6	0.4	—	—	—	—
DYTOL S-91	Decyl, C_{10}	0.6	98.8	0.6	—	—	—
DYTOL B-35	Lauryl, C_{12}	—	0.3	61.2	25.4	13.1	—
DYTOL A-24	Lauryl, C_{12}	—	0.7	67.8	31.0	0.5	—
DYTOL J-68	Lauryl, C_{12}	—	0.4	81.5	17.8	0.3	—
DYTOL L-79	Lauryl, C_{12}	—	—	99.1	0.9	—	—
DYTOL R-52	Myristyl, C_{14}	—	—	0.6	97.6	1.8	—
DYTOL F-11	Cetyl, C_{16}	—	—	0.1	1.1	98.2	0.6
DYTOL E-46	Cetyl, C_{16}; Stearyl, C_{18}	—	—	0.1	1.9	35.6	62.4

OTHER ORGANIC CHEMICALS



Acetone Cyanohydrin



Dodecenyl Chloride

$N \equiv C - CH_2CH_2COOCH_3$

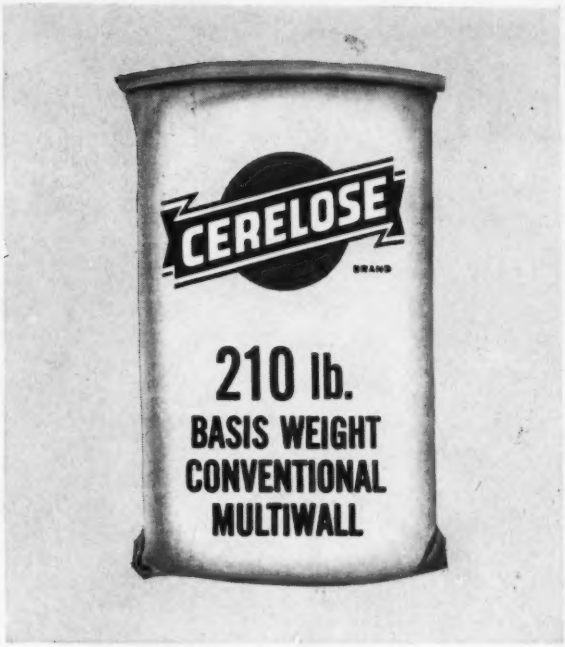
Methyl Cyanopropionate

Acetone cyanohydrin is available commercially; dodecenyl chloride and methyl cyanopropionate in development quantities.

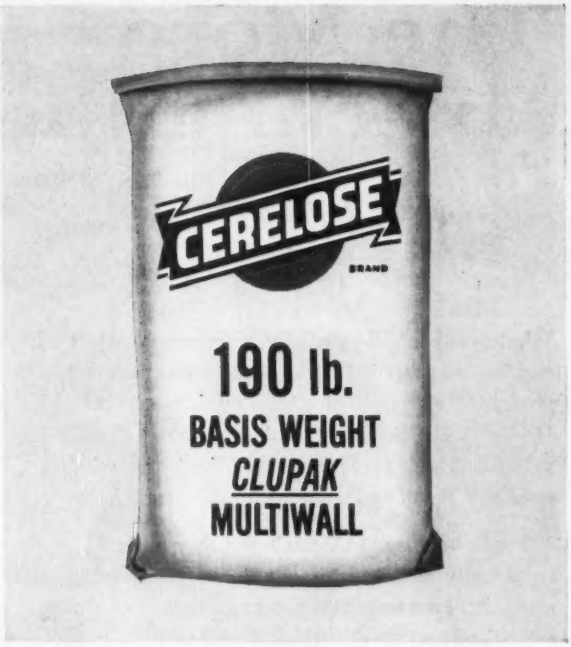
DMP, PRIMENE, and DYTOL are trademarks, Reg. U.S. Pat. Off. DMP and PRIMENE are also registered in Canada.

For additional literature, price schedules, and samples of our organic chemicals, write to Dept. SP-45.

ROHM & HAAS
PHILADELPHIA 5, PA.
PRINTED IN U. S. A.



BEFORE: 5-ply conventional kraft bag (4 plies of 40 lb. kraft and one 50 lb.)
% of bags damaged: 1.5%



AFTER: 4-ply multiwall CLUPAK extensible paper (2 plies of 40 lb., one 50 lb., one 60 lb.)
% of bags damaged: 0.17%

CORN PRODUCTS CO. cuts bag damage 88%
with *CLUPAK* extensible paper multiwalls

Loss of product in shipping, and consequent annoyance to customers, was a headache Corn Products Company wanted to remedy. CLUPAK extensible paper multiwalls, because they g-i-v-e to absorb strain and impact, sharply reduced bag breakage—a boon to customer relations.

In tests conducted last year by Corn Products Company, the normal damage rate of 9 bags per 600-bag car was reduced to only one bag in 600—using CLUPAK multiwalls!

Ask your paper salesman about a trial shipment of CLUPAK extensible paper multiwalls.

EXTENSIBLE CLUPAK PAPER **Compared to conventional kraft of equal basis weight has:**

- Up to 7 times more controlled machine direction stretch.
- 3 to 5 times greater ability to withstand impact and shock.
- 10 to 20% increase in cross direction stretch.
- 40% improved puncture resistance.
- Identical surface properties and printability.

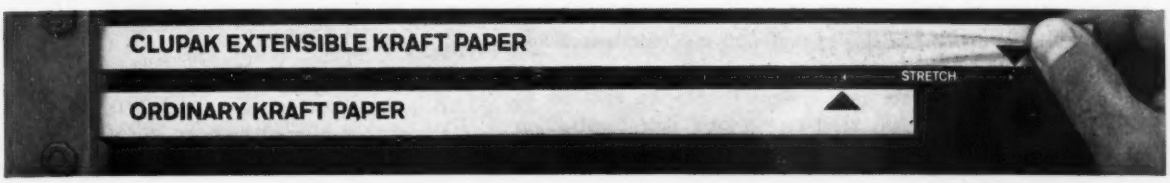
EXTENSIBLE CLUPAK® PAPER *

"it stretches to shrink your costs"

*CLUPAK, Inc.'s trademark for extensible paper manufactured under its authority and satisfying its specifications. CLUPAK, Inc., 530 5th Ave., N. Y. 36, N. Y.

For information, contact the Clupak licensee nearest you:

ALBEMARLE PAPER MFG. CO. • CALCASIEU PAPER CO. • CONTINENTAL CAN CO., INC. • CROWN ZELLERBACH CORP. HUDSON PULP AND PAPER CORP. • INTERNATIONAL PAPER CO. • ST. REGIS PAPER CO. • UNION BAG-CAMP PAPER CORP. • WEST VIRGINIA PULP AND PAPER • For Canadian and Foreign Licensees write Clupak, Inc., 530 5th Ave., New York 36, New York



The More Exacting the Mix

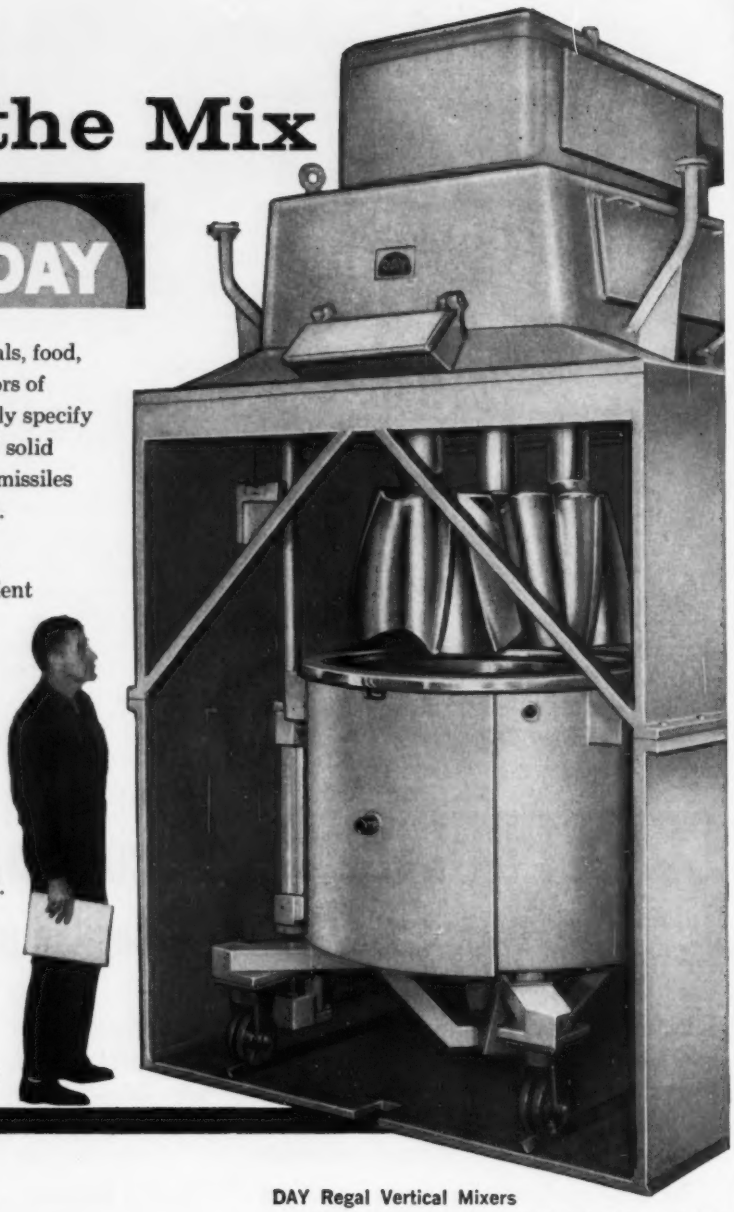
...the greater the need for DAY

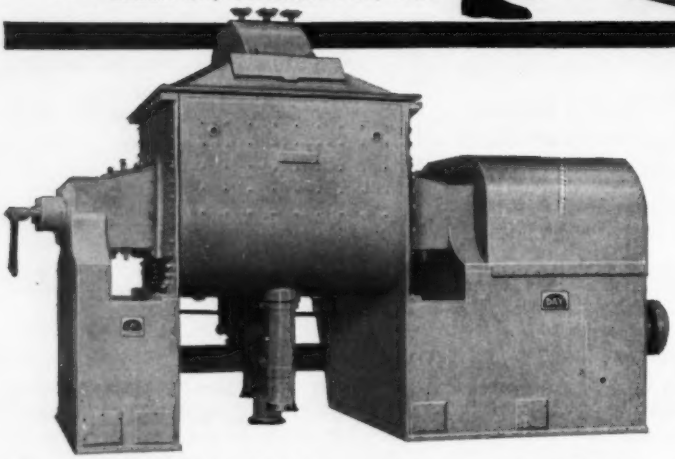
Whatever the field—rocketry, pharmaceuticals, food, or a host of other industries—major processors of products that require precision mixing usually specify DAY MIXERS. For example, producers of solid propellant fuels for Polaris and Minuteman missiles use DAY Regal and Titan mixers illustrated.

That's because DAY mixing equipment is specifically designed for safe, fast and efficient operation even under the most exacting conditions and specifications. For nearly 75 years, DAY processing machinery has been industry-recognized for superior performance, ruggedness, and thorough dependability.

Choose the right mixer for your jobs from DAY's complete line of types and sizes for *every* mixing need—powder, paste, or liquid. Write for detailed information, or call a J. H. Day Company field engineer.

THE **J.H.DAY** CO.
Division of The Cleveland Automatic Machine Co.
QUALITY MIXING, BLENDING, MILLING
AND SIFTING EQUIPMENT SINCE 1887
4928 BEECH ST., CINCINNATI 12, OHIO





DAY Titan Horizontal Mixers, designed primarily for the rocket fuel industry, feature extreme mixing control with maximum speed and safety for practically every field — various types of agitators, heating and cooling, sanitation, vacuum operation. Double-arm agitators fit closely in machined stainless steel tanks; extra rigid construction prevents flexing and weaving.

DAY Regal Vertical Mixers provide fast, accurate, controlled mixing. Triple agitator orbiting action mixes in ¼ to ⅓ the time of most horizontal double-arm mixers; "Change Can" principle further speeds the operation, thus reducing total processing time 50% or more compared to other types. Stainless steel cans, caster or trolley-mounted, are available with jacketing or for vacuum mixing. No stuffing boxes in product zone — no product contamination or damage to bearings.

DAY'S complete line of Double-Arm Dispersion Mixers includes 4 models, more than 25 sizes—for every need from laboratory to massive production. Check your requirements against specifications in these catalogs.

CYANAMID

For the first time, the cyanamide radical is available as a stable, colorless, concentrated 50% aqueous solution of **hydrogen** cyanamide. And it sells for only 10¢ a pound!

This new form of an old and useful compound contains a minimum of metallic and nitrogenous contaminants. For full details, send for your free copy of our data sheet on Hydrogen Cyanamide and/or the comprehensive technical manual, "Cyanamide by Cyanamid," and a sample.

SOME PRODUCTS OF CYANAMID'S PROCESS CHEMICALS DEPARTMENT:
ACCOBOND® Resins • AEROCARB®, AEROCASE®, AEROHEAT® Metal Treating Compounds • AEROSOL® Surface Active Agents CYQUEST* Sequestering Agents • HYFORM® Emulsions • Ammonium Sulfate Ferrous Sulfate (Copperas) • Lime and Limestone • Mineral Acids • Aluminum Sulfate

Products Marketed Under the AERO® Trademark are:
Ammonium Nitrate • Calcium Carbide • Calcium and Hydrogen Cyanamides Cyanuric Chloride • Dialkyl Maleates • Dicyandiamide • Glycolonitrile • HCN (liquid Hydrocyanic Acid) • Maleic Anhydride • Metallic Stearates Phthalic Anhydride • Ferrocyanides • Urea, Crystals and Uncoated Prills
*Trademark

AMERICAN CYANAMID COMPANY
PROCESS CHEMICALS DEPARTMENT • 30 Rockefeller Plaza, New York 20, N. Y.

American Cyanamid Company CWP-99
Process Chemicals Department
30 Rockefeller Plaza, N. Y. 20, N. Y.

Please send me:
☐ "HYDROGEN CYANAMIDE" Data Sheet
☐ "CYANAMIDE BY CYANAMID" Technical Manual
☐ A sample of Hydrogen Cyanamide

Name_____
Position_____
Company_____
Address_____
City_____ Zone____ State_____

EXTRA BENEFITS GO INTO EVERY SHIPMENT OF

MATHIESON SULFURIC ACID

Dependable Supply and strategic locations assure you quick delivery of all commercial grades. Plants and shipping points in Beaumont, Port Arthur, Pasadena, Tex.; Little Rock, Ark.; Bossier City, La.; Joliet, Ill.; Baltimore, Md.

Acid Recovery can be as important as acid supply. Count on Mathieson's many years of experience in spent acid handling to help you determine the most advantageous disposal of your spent material.

Safety of your personnel is of primary concern in any process requiring acid handling. For new operations and new employees, you will need complete safety and handling instructions. We supply these in both literature and wall charts.

Technical Assistance is also part of our package. The on-the-spot knowledge of your Mathieson man and our laboratory facilities are at your disposal. Call or write OLIN MATHIESON, Baltimore 3, Md.

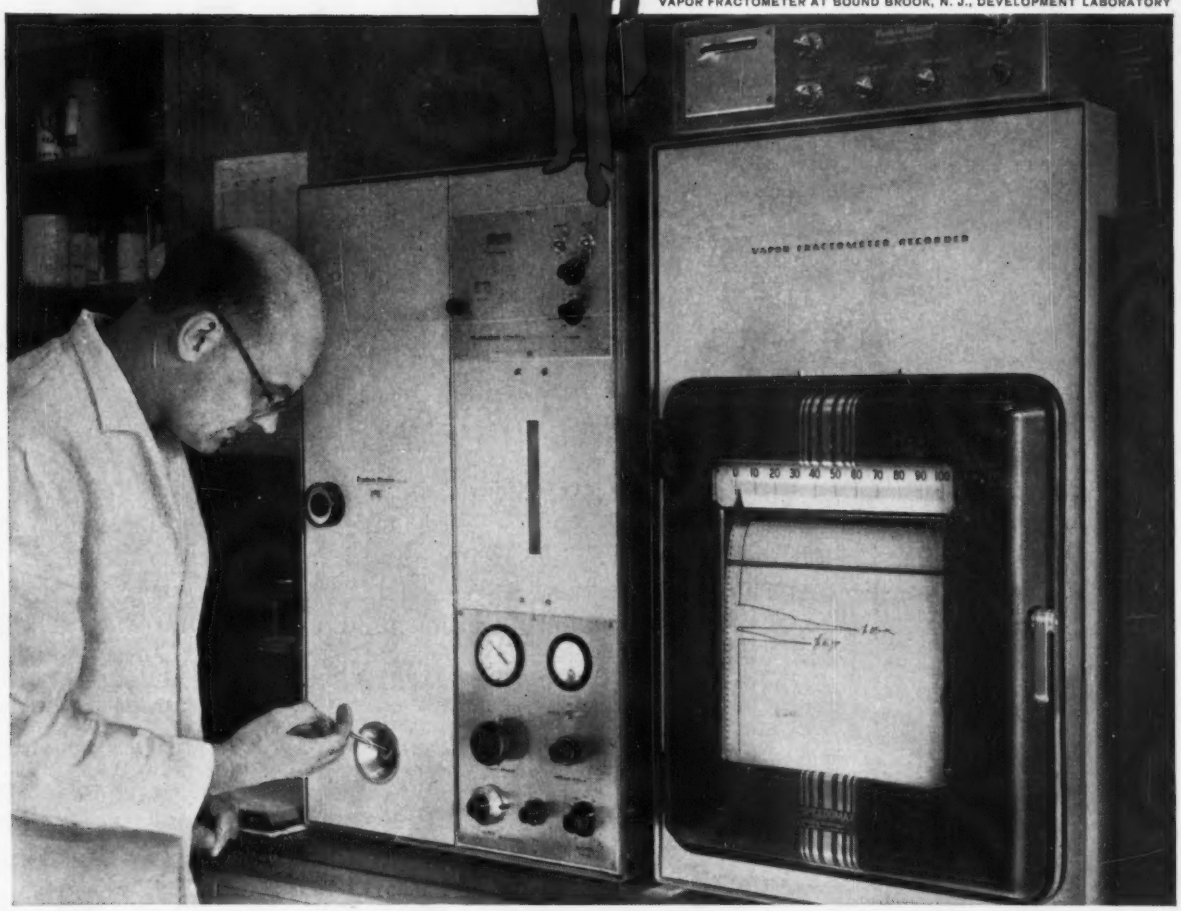
Ammonia • Sodium Bicarbonate • Carbon Dioxide • Caustic Soda • Chlorine • Hydrazine and Derivatives • Hypochlorite Products • Methanol • Muriatic Acid • Sodium Nitrate • Nitric Acid • Soda Ash • Sodium Chlorate • Sodium Chlorite Products • Sodium Methylate • Sulfur (Processed) • Sulfuric Acid • Urea

1313

CHEMICALS DIVISION Olin

THE MAN FROM AIRCO IS BACKED BY EXTENSIVE RESEARCH FACILITIES

VAPOR FRACTOMETER AT BOUND BROOK, N. J., DEVELOPMENT LABORATORY



...TO HELP YOU FIND MORE PROFITABLE WAYS TO USE AIRCO VINYL ACETATE MONOMER

Research in vinyl acetate monomers at Airco is a continuing effort. Chances are Airco has already solved many of the monomer problems you may run into . . . and new answers are being worked out every day. Airco research teams are constantly searching for new applications that may prove commercially useful; new, more economical methods to replace the old; profitable ways to use monomers at lower cost.

If you can use this specific monomer know-how, call the man from Airco.

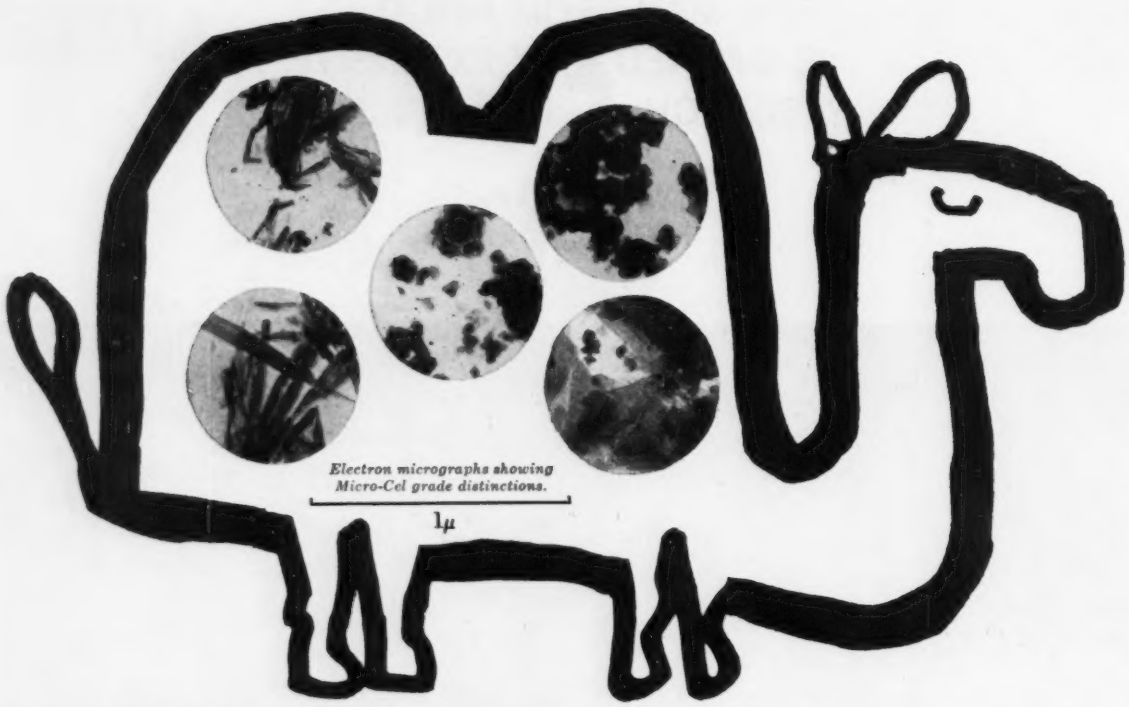
AIR REDUCTION CHEMICAL & CARBIDE CO.

A DIVISION OF AIR REDUCTION COMPANY, INCORPORATED • 150 EAST 42nd STREET, NEW YORK 17, NEW YORK • MURRAY HILL 2-6700

AIRCO — Vinyl Monomers, Acetylenic Chemicals

Calcium Carbide, Pipeline Acetylene

COLTON — Vinyl Resins, Copolymers



Micro-Cel holds water like a camel!

Micro-Cel®, Johns-Manville's new line of synthetic calcium silicates, absorbs up to 6 times its weight in water . . . remains a free-flowing powder after absorbing triple its weight in liquid. 4½ lbs. bulk to a full cu. ft. Costs only 7 to 8¢ a lb. (F.O.B.). Surface areas up to 175 sq. m/gr. Micro-Cel, available in several grades and offering a wide range of physical properties, may provide the cost-cutting answer to your formulating problems. For further information, samples and assistance, mail in coupon!

JOHNS-MANVILLE
Celite Division

1961

JOHNS-MANVILLE, Box 325, New York 16, N. Y.
In Canada: Port Credit, Ontario.

☐ Please send additional data.

☐ Please send free sample of suitable grade of Micro-Cel for use in:_____

☐ Have local Sales Engineer contact me.

Name_____ Position_____

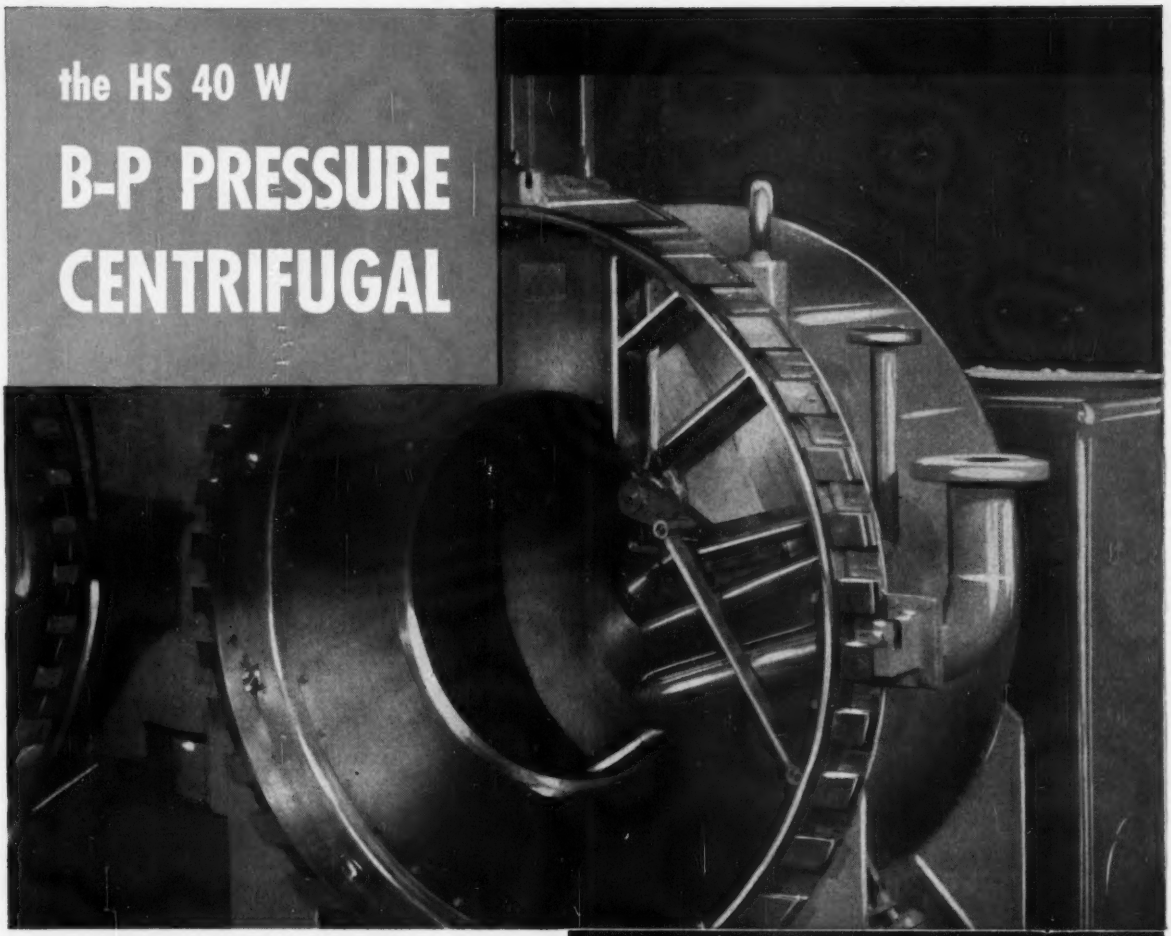
Company_____

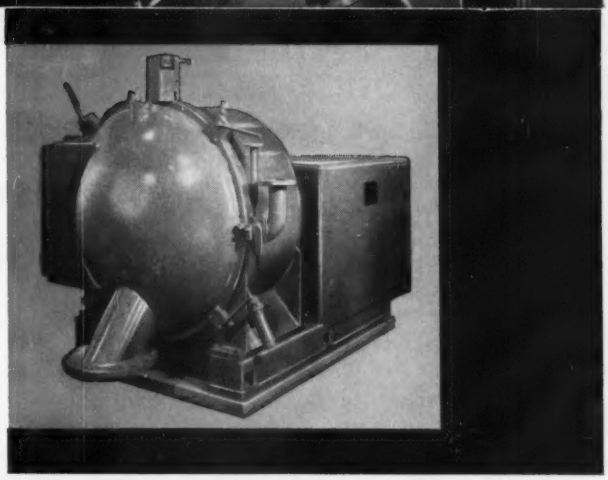
Address_____

City_____ Zone____ County_____ State____

the HS 40 W

B-P PRESSURE CENTRIFUGAL

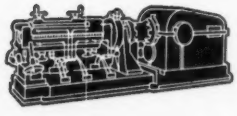


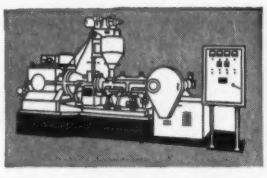


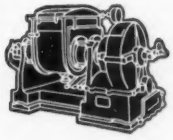
BAKER PERKINS research now brings you the HS 40 W Universal Pressure Centrifugal, engineered for normal operation at 1000 times gravity and internal pressures to 150 psi. Several important features are entirely new: A MECHANICAL SELF-BALANCING SHAFT SEAL is positioned where the main shaft enters the housing and is the only major moving seal. A CLAMPING AND SELF-ALIGNING DOOR SEAL consisting of a floating ring plus two O-rings assures a completely safe lock without the necessity of tightening bolts. A SIMPLIFIED DESIGN OF THE DISCHARGE KNIFE AND CHUTE. Complete discharge of all solids is effected, eliminating swirling or dusting of solids within the housing. PROGRESSIVE PEELING. For the first time, provision is made for the peeler knife to enter the cake at successively increasing depths. Glazing of the heel is eliminated. Air displacement is controlled during both the charging and peeling operations.

As in all Baker Perkins Universal Centrifugals, the interior of the new model is completely and readily accessible. For complete specifications of the high capacity HS 40 W Universal Pressure Centrifugal, see your B-P sales representative or write to:

BAKER PERKINS INC.



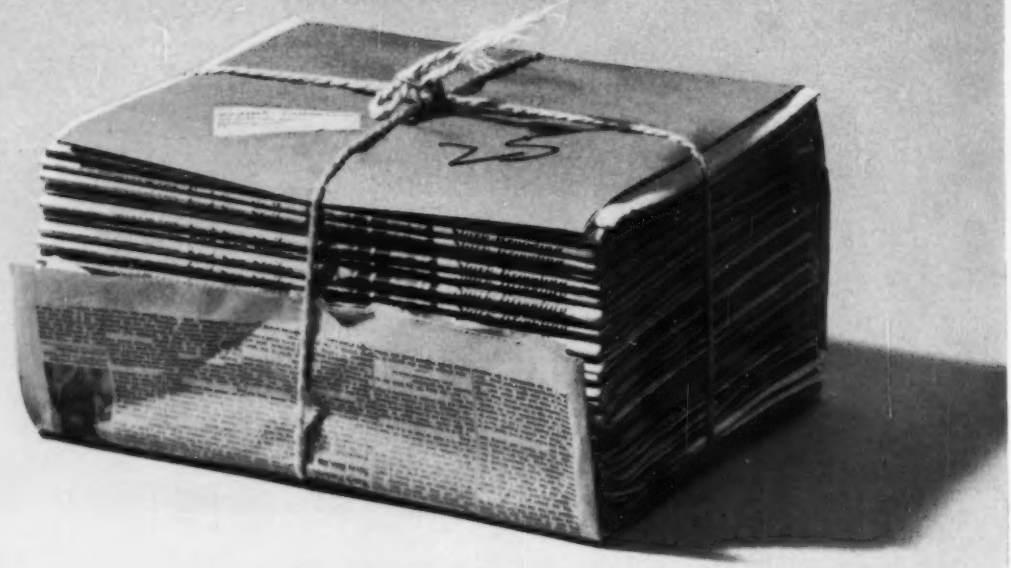




394R

CONTINUOUS MIXERS • PLASTICS MACHINERY • UNIVERSAL MIXERS SAGINAW, MICHIGAN

NEWS



from Du Pont for users of ε-CAPROLACTAM

NOW you can get Caprolactam monomer in flaked or molten form from Du Pont's new 50-million-pounds-a-year market plant. Deliveries now being made. Quality has proven extra high, for making nylon 6 and other products. For full details on this major new source of supply, contact Chemical Products Sales Division, Explosives Department, Du Pont Company, 6539 Nemours Building, Wilmington 98, Delaware . . . or any of the following branch offices.

BRANCH OFFICES: **BOSTON**: 140 FEDERAL ST., HA 6-1724 / **CHARLOTTE**: 427 W. FOURTH ST., FR 5-5561 / **CHICAGO**: 7250 N. CICERO AVE., LINCOLNWOOD, OR 5-1010 (FROM CHICAGO, IN 3-7250) / **CLEVELAND**: 11900 SHAKER BLVD., LO 1-5070 / **HOUSTON**: P.O. BOX 22207, MO 7-9197 / **LOS ANGELES**: 2930 EAST 44TH ST., LU 2-6464 / **NEW YORK**: 4700 EMPIRE STATE BLDG., LO 3-6400.

Better Things for Better Living . . . *through Chemistry* DU PONT REG. U.S. PAT. OFF.

FOR PRODUCTION ECONOMY

TO STOP CORROSION, DOWNTIME, AND PRODUCT LOSSES

The complete inertness of Fluoroflex*, Resistoflex's specially processed Teflon† construction material, is well known. The fact that Fluoroflex exhibits zero corrosion to all acids, chemicals, and solvents up to 500°F. (except free fluorine and alkali metals at elevated temperatures) is one reason for the completely successful and satisfactory use of Fluoroflex in hundreds of process plants both here and abroad.

Because of this superior performance, one might expect a Fluoroflex system to be more expensive than it is. However, on an installed cost basis, Fluoroflex-lined steel piping is today comparable with or cheaper than pressure-piping of several high-nickel alloys.

As a result leading engineering-construction firms now use Fluoroflex rigid piping systems and flexible components in new plant construction to stop corrosion or contamination and to reduce erection costs.

■ **Fluoroflex preflanged piping** eliminates cutting chamfering, cleaning, welding, scale, flux, weld spatter and annealing—minimizes the need for gaskets, hangers, supports, and anchors as required for non-metallic piping.

Many small processing columns can be assembled from sections of Fluoroflex-lined pipe for rectifying, absorption, and scrubbing operations. Packed Fluoroflex-lined columns complete with Fluoroflex distributor and support plates and Raschig rings can be fabricated in sizes up to 10 inch diameter.

■ Resistoflex also manufactures a complete line of bellows and expansion joints, transfer hose, dip pipes, spargers, and thermowells.

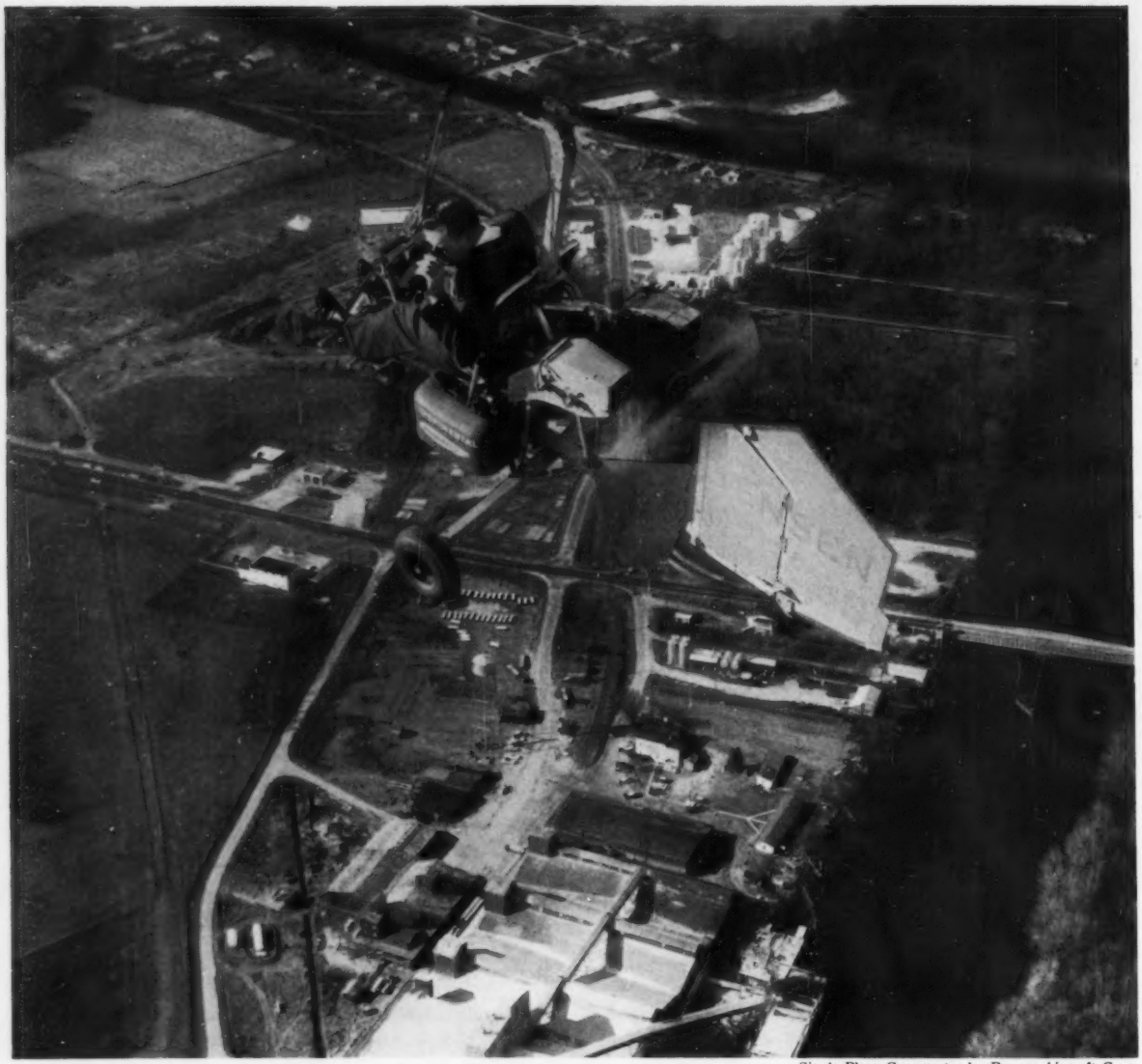
If you have corrosive fluid-handling problems, SPECIFY FLUOROFLEX. Write to Resistoflex Corporation for detailed information today, or ask our local service engineer to call. Plants in ROSELAND, N. J., Anaheim, Calif., Dallas, Tex. Sales offices in major cities.

*Resistoflex T.M.
†DuPont T.M.

Complete systems for corrosive service

RESISTOFLEX
RELIABILITY

SEE US AT THE CHEMICAL INDUSTRIES SHOW, BOOTHS 893, 895, 897, N. Y. COLISEUM · NOV. 27 TO DEC. 1

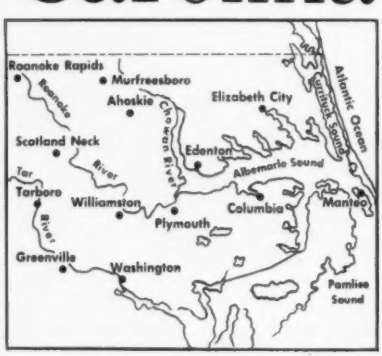


Single-Place Gyrocopter by Bensen Aircraft Corp.

Looking for production savings?

Look into Northeastern North Carolina

Few advantages can yield such savings as a willing, conservative work force and a contented staff. And Northeastern North Carolina can help you enjoy both. The state home-grows two workers for every one who retires or moves. And this area's hospitable communities, magnificent beaches, lakes and rivers . . . set in a mild, vacationland climate . . . make it easier to move key personnel here. Write, wire or phone VEPCO for plant site and economic data on this growing industrial area within overnight range of New York, Pittsburgh, Cincinnati and Atlanta.



VEPCO VIRGINIA ELECTRIC and POWER COMPANY

Clark P. Spellman, Manager—Area Development, Electric Building, Richmond 9, Virginia • MIlton 9-1411
Serving the Top-of-the-South with 2,086,000 kilowatts—due to reach 2,720,000 kilowatts by 1963.

useful intermediates

THESE BENZOL PRODUCTS COMPANY SPECIALTIES ARE IMMEDIATELY AVAILABLE:

1 **AMINO ACETIC ACID**

$NH_2 \cdot CH_2 \cdot COOH$

2 **BENZILIC ACID**

$C_6H_5 - \underset{\displaystyle COOH}{\overset{\displaystyle OH}{\underset{|}{\overset{|}{C}}}} - C_6H_5$

3 **BENZOIN**

$C_6H_5 \cdot CH\,(OH) \cdot CO \cdot C_6H_5$

4 **CHLOROACETONITRILE**

$Cl \cdot CH_2 \cdot CN$

5 **CHRYSANTHEMUM MONOCARBOXYLIC ACID ETHYL ESTER**

$(CH_3)_2 \cdot C - CH \cdot CH = C\,(CH_3)_2$

$\quad\quad\quad

formaldehyde from Allied Chemical is ready to ship. Night or day, just call us and we start loading a truck from our bulk formaldehyde terminal nearest you. Odds are your shipment will be at your plant before you pull in the gate next morning. Of course we ship by tankcar too – from our South Point, Ohio, plant in 10,000- and 8,000-gallon resin-lined cars. • Service as you like it when you like it is a habit with us. So is a product that is low in acid, iron and non-volatiles and tops in quality. Why not get this service and quality by making Allied Chemical formaldehyde a habit with you. Just call.

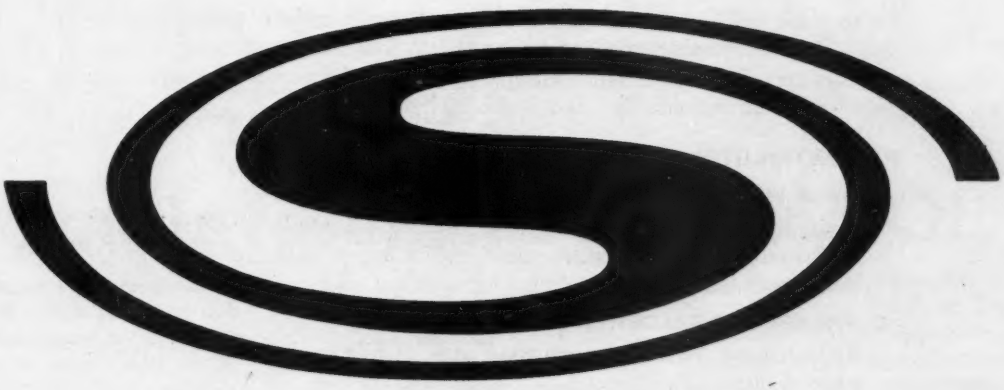
For specs and local offices, see Chem. Materials Catalog, page 272A; Chem. Week Buyer's Guide, page 27. 2819

Allied Chemical

BASIC TO AMERICA'S PROGRESS

NITROGEN DIVISION
Dept. F5-7-2, 40 Rector Street, New York 6, N.Y.

NOW THE SWIRL HAS A NEW LOOK

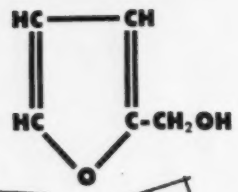


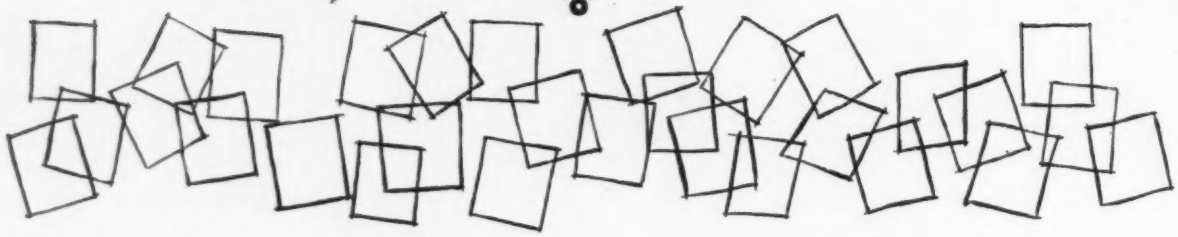
The *new look* of the *Swirl* reflects the expanded energies of a company with the capacity to quicken the pace in the advancement of centrifugal separation of liquids and liquid-solid mixtures.

Look for the *new Swirl.* You'll find it wherever The Sharples Corporation and its subsidiaries throughout the world are helping customers improve quality, increase yield, reduce time, salvage waste. It's a *Swirl World* whenever you think of centrifuge equipment, systems, plants . . . for industrial processing. The Sharples Corporation, 2300 Westmoreland Street, Philadelphia 40, Pa.

SHARPLES

REPRESENTATIVES AND ASSOCIATED COMPANIES THROUGHOUT THE WORLD





QO® FURFURYL ALCOHOL AS A RESIN MODIFIER

Furfuryl alcohol (FA)® has a marked effect on the properties of urea-formaldehyde, phenol-formaldehyde and epoxy resins, increasing the value of these resins in specific areas of application. Many industrial uses are based on the "plus" factor to be found in furfuryl alcohol modified resins.

FA CONTRIBUTES DESIRABLE PROPERTIES TO:

1. **UREA FORMALDEHYDE RESINS**
   by improving gap-filling, craze resistance, stability to heat and aging and by lowering gas evolution. In addition, FA improves the relationship between pot life and curing speed.
2. **PHENOL FORMALDEHYDE RESINS**
   by increasing the resistance to alkali attack while retaining the acid resistance of phenolics.
3. **EPOXY RESINS**
   by functioning as a reactive solvent and increasing the flexural strength of the final product.

Specific questions invited. For general information about QO furfuryl alcohol, write for Bulletin 205.

The Quaker Oats Company

CHEMICALS DIVISION

The Quaker Oats Company — CHEMICALS DIVISION — QO QUAKER CHEMICALS

336H, The Merchandise Mart,
Chicago 54, Illinois

Room 536H, 120 Wall St.,
New York 5, N. Y.

Room 436H, 49 S.E. Clay Street
Portland 14, Oregon

In the United Kingdom:
Imperial Chemical Industries, Ltd., London, England

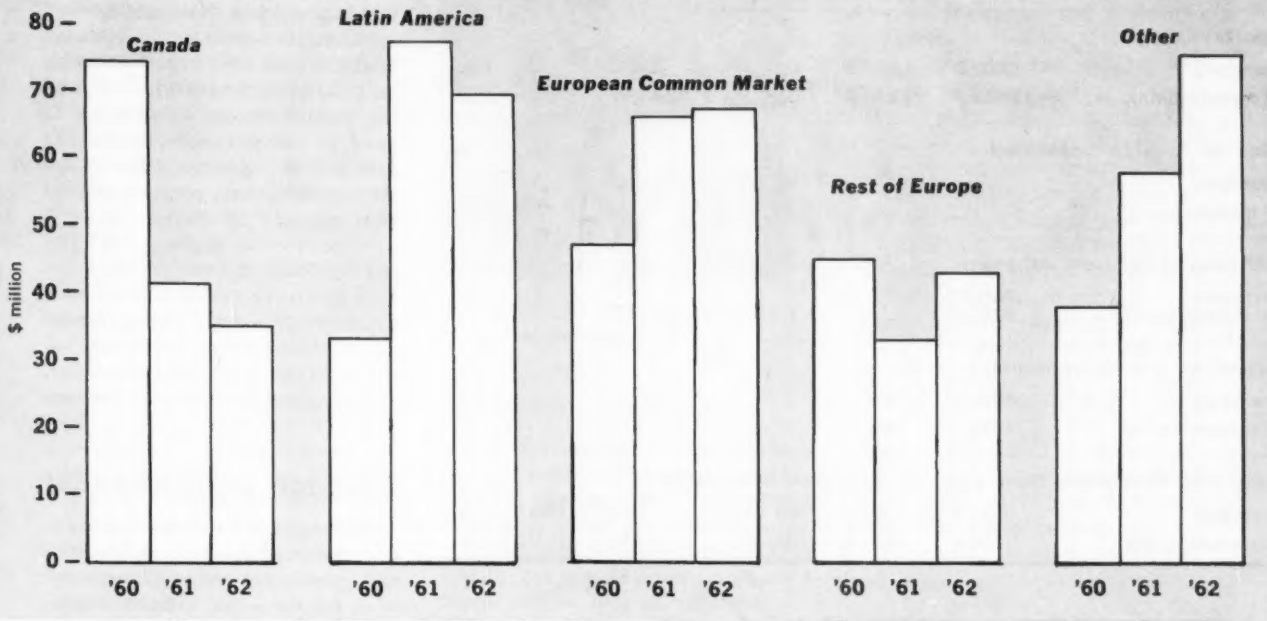
In Europe:
Quaker Oats (France) S. A., 3, Rue Pillet-Will, Paris IX, France;
Imperial Chemical Industries (Holland) N.V., Rotterdam, Holland
Imperial Chemical Industries (Export) Ltd., Frankfurt a.M., Germany

In Australia:
Swift & Company, Ltd., Sydney

In Japan:
F. Kanematsu & Company, Ltd., Tokyo

Chemical Week / SEPTEMBER 9, 1961

U.S. Chemical Companies' Overseas Spending Plans



Foreign Investments Leveling Off

U.S. producers of chemicals and allied products expect their high rate of overseas investment to level off in '62, and to be more evenly distributed, geographically. They expect exports to grow this year and next at a modest rate, while their overseas subsidiaries make major sales gains. These subsidiaries are operating at a higher rate of capacity than their U.S. counterparts. They will be returning an increasing share of their profits to the U.S., but will be purchasing less of their equipment here.

These are some of the findings of McGraw-Hill's new survey of overseas business plans, tabulated from data received last month.

The chemical industry's leveling-off of overseas expenditures in '62 is expected to be less pronounced than that of manufacturing industries as a whole. For all manufacturing industries, overseas spending in '62 is expected to drop 1%, after a two-year rise. Producers of chemicals and allied products, on the other hand, will still increase their outlays 5% in '62, though this represents a tapering off from this year's expected 16% boost.

The spending trend varies within other sectors of the process industries. Paper producers plan to cut foreign outlays to $72 million this year and $69 million in '62. For '60, the figure was $78 million. But stone, clay and glass makers plan to boost outlays to $44 million this year and $48 million in '62 ('60: $37 million). And rubber companies will also spend more, increasing investments from $68 million last year to $73 million in '61 and $80 million in '62.

Shying Off? For the first time, McGraw-Hill's survey results have been adjusted to represent spending by all manufacturing and petroleum companies, and are directly comparable with the recently released (but in some aspects less detailed) survey results of the U.S. Dept. of Commerce.

Nevertheless, there are some notable divergences in the results of the two surveys, even though the general trends coincide. Commerce Dept., for example, found chemical companies planning to boost expenditures this year 21.5%, compared with the 16% boost indicated by McGraw-Hill's findings. (The two surveys are, however, in rough agreement on the '62 rise.) And for all manufacturing, the Commerce Dept. found a 31.3% rise expected this year, compared with the 25% indicated by McGraw-Hill's findings. For '62, the two surveys disagree in reverse: Commerce shows outlays down 2.8%, while McGraw-Hill shows the decline to be less sharp —only 1%.

One reason for these discrepancies may be differences in sampling. But the timing of the surveys may also be significant. Commerce received its replies two or three months earlier than McGraw-Hill did. In the interval the Berlin crisis became more alarming, the Administration's tax bill receded

U.S. Chemical Industry's Overseas Business Plans

(millions of dollars)

	'60	'61	Change	'62	Change
Capital Expenditures					
Chemicals	237	275	Up 16%	289	Up 5%
All manufacturing	1,337	1,666	Up 25%	1,651	Down 1%
Exports					
Chemicals	1,802.3	1,838.8	Up 2%	1,875.6	Up 2%
All manufacturing	13,452.9	13,838.0	Up 3%	14,295	Up 3%
Sales of Foreign Subsidiaries					
Chemicals			Up 9%		Up 13%
All manufacturing			Up 6%		Up 10%
Operating Rate (end of year)					
Chemicals	86%				
All manufacturing	88%				
Portion of profits returned to U.S.					
Chemicals	55%	74%			
All manufacturing	43%	44%			
Equipment Purchases from U.S. for Overseas Investment					
Chemicals	33.2	60.5	Up 82%	54.9	Down 9%
All manufacturing	1,200.6	1,438.8	Up 20%	1,448.4	Up 0.7%

as an imminent threat to overseas business profits, and Britain moved much closer to joining the Common Market. All of these factors could have a bearing on overseas investment plans. But it's worth noting that four major companies queried by *CW*—Du Pont, Union Carbide, Dow, and Monsanto—say that the Berlin crisis has not affected their European investment plans.

Spreading It Around: One of the most revealing findings of the McGraw-Hill survey is the shift in geographic emphasis planned by the chemical industry. Europe, and the Common Market in particular, continues to be the principal magnet for U.S. investment. Producers of chemicals and allied products spent 39% of their investments in Europe in '60, plan to spend 36% this year and 38% in '62. The Common Market will get, for those years, 19.8%, 24%, and 23%, respectively, while the rest of Europe's share will fall.

But the survey also reveals a new trend—the buildup of investments in areas outside of Canada, Latin America, and Europe. This would include Africa, the Middle East and the rest of Asia, and Australia. This "other" category accounted for 16% of chemical industry foreign investment in 1960, will get 21.1% this year and 26% in '62. The total for this group in '62 will exceed the Common Market total. This trend contrasts with the trend of all manufacturing, for which investments in these areas will increase only slightly as a share of the total. It also contrasts with the plans of major chemical producers queried by *CW*. It is probably explained by the activities of fertilizer, pharmaceutical, and synthetic fiber producers in places like Taiwan, India, Pakistan, etc., as well as by some industrial and specialty chemical investment in Japan, Australia and Taiwan.

This shift to new territory will be at the expense of investment in Canada, primarily.

Business Even Better: Chemical producers, and manufacturers in general, are fairly optimistic about exports. They are much more bullish about sales from their plants abroad, which will rise sharply as new plants begin operating, presumably allowing a greater flowback of profits.

Merger Gains a Friend

El Paso Natural Gas Co.—which is in petrochemicals via a joint polyolefin venture with Rexall Drug and Chemical—is now expected to get a green light from the U.S. Supreme Court for its proposed merger with Pacific Northwest Pipeline Co.

Prospects for this consolidation brightened last week when U.S. Solicitor General Archibald Cox sided with the Federal Power Commission in favor of the proposed merger. The Justice Dept.'s Antitrust Division and the California state government have been opposing the move.

When the antitrusters first filed suit to block the merger, they argued that unification of the two companies would mean a virtual monopoly in interstate gas service west of the Rockies. Since then, however, other pipelines have entered the area.

Chicago Doubleheader

Possibly 12,000 chemists and chemical engineers from industry, education and government are in Chicago this week for the 140th national meeting of the American Chemical Society and the 11th National Chemical Exposition.

Highlights of the ACS technical program: first session of the society's new Division of Microbial Chemistry and Technology, with papers on large-scale growing of viruses for vaccine production and new fermentation techniques for waste disposal; and a two-day symposium on "Polymerization and Polycondensation Processes" for the Society's Division of Industrial and Engineering Chemistry. This symposium will feature reports from U.S. and foreign specialists such as Procter & Gamble's A. Kessler ($C_{12\text{-}18}$ α-olefins by ethylene polymerization), Dow's J. W. Vanderhoff (inverse emulsion polymerization), and H. Hopff—now with the Swiss Federal Institute of Technology, formerly research director of Germany's Badische Anilin-und Soda Fabrik (processes for high- and low-pressure polyethylene).

Scheduled as the main address of the meeting: "Professional Training in Chemistry," a talk by ACS President Arthur C. Cope, head of the chemistry department at Massachusetts Institute of Technology.

Chemicals Down East

Spokesmen for Maine industry predicted slow but steady growth for local chemical manufacturing last week at the state's first industrial products show. Held at the Augusta State Armory, the display sampled Maine-made goods (e.g., metal, marine, and forest products), attracted consuls and trade attaches from 10 foreign countries, government procurement officials, and purchasing agents from across the nation.

Fifty firms, six federal agencies and four Maine governmental departments participated in the exhibition, which was sponsored by the state's Dept. of Economic Development. Gross state product exceeded $1.5 billion last year, according to DED Commissioner Lloyd K. Allen.

Chemicals (about $17 million worth produced in '58) are small potatoes beside paper and allied products ($364 million). But research may enhance the relative importance of chemicals, believes Thomas Curry, director of the University of Maine's Technology Experiment Station. Transportation costs are too high to encourage heavy chemical producers, Curry acknowledges. But he expects paper and textile chemical output to rise, and notes that these products are the object of vigorous research at the University.

Frederick Frost, research vice-president and member of the board of directors of S. D. Warren Co. (Westbrook, Me.), sees "no limit to the development of the paper industry in Maine or anywhere else." Frost expects paper reproduction plates (an inexpensive method of printing illustrations) to capture a $40 - 50 million annual market by '65. He also likes the outlook for a new mirror-finish paper in packaging, and a novel synthetic leather made by coating an organosol on paper, foaming the organosol by means of blowing agents, then stripping the film from the paper.

Frost says it's now impossible to distinguish between the paper and chemical industries, explains that Warren is plunging into "all phases of chemical industries, explains that Warphotosensitive materials).

Marine Colloids (New York), which extracts carrageenin from Irish moss at its Rockland plant, is completing three new drying plants.

Armour's Prince: Seeking $60 million to finance chemical growth.

Borrowing to Build

To help finance its chemical growth, Armour and Co. (Chicago) last week moved to raise more than $32 million on an issue of 4½% convertible subordinated debentures due Sept. 1, '83. Initially, the new debentures are being offered only to Armour stockholders.

Armour Chairman William Wood Prince has made it clear that he intends to reverse his company's traditional alignment and build up its chemical operations to a point where they exceed the company's food business. He notes in the prospectus that, although Armour Foods has accounted for more than 85% of gross volume in recent years, it has brought in less than 50% of earnings.

In the $90-million capital expenditure program for '61 and '62, Armour is allotting $60 million to expansion in chemical fertilizer materials. Principal chemical projects under construction are two plants that will about triple Armour's capacity for phosphate and nitrogen fertilizer materials. These are a $24-million plant in Polk county, Fla., to produce phosphoric acid and triple superphosphate; and a $25-million plant to produce ammonia, nitric acid and other nitrogen derivatives near Cherokee, Ala. (*CW Business Newsletter, May 6*). Both of these plants are to be onstream by mid-'62.

Prince adds that the company also is considering construction of several mixed fertilizer plants.

Room for Six More?

At least six more hardwood pulp mills can be accommodated in the Tennessee River Valley, according to the Tennessee Valley Authority's Division of Forestry.

This finding—detailed in a report now available from the division's headquarters at Norris, Tenn.—is expected to provoke both industry interest and public comment.

Eleven years ago, TVA foresters issued a similar report about potential for a pinewood newsprint mill, and the U.S. Forestry Service objected that there weren't enough pine trees for such a mill. Nevertheless, Bowaters Southern Co. put up a newsprint mill that's still going strong.

Later, Bowaters foresters insisted there wasn't enough timber for the pulp mill recently opened at Counce, Tenn., by Tennessee River Pulp and Paper Co.

Director Kenneth J. Seigworth of TVA's Division of Forestry says there are now seven pulp mills in the Valley region with combined capacity of 3,581 tons/day. Wood purchased for those mills in '59 totaled 495,000 cords of hardwoods and 905,000 cords of pine.

Catalin Adds a Fourth

Catalin Corp. (New York) is beefing up its sales position on the West Coast by acquiring Lebec Chemical Corp. (Paramount, Calif.) in a straight cash transaction. Catalin also is taking over Pomar Corp., owner of the four-acre tract on which the Lebec plant stands.

This move gives Catalin a fourth producing facility (others are in Fords, N.J.; Calumet City, Ill.; and Thomasville, N.C.) and broadens the company's line of synthetic resins. Lebec produces phenolic, cresylic, acrylic, formaldehyde, urea and melamine resins. Catalin President Harry Krehbiel estimates the acquisition will add 5-10% to Catalin's sales volume, which last year was $19.3 million.

John C. Plummer, 47, president and principal stockholder of Lebec, has been named a director and vice-president of Catalin.

Terms provide for initial payment of more than 50% of the purchase price, with the remainder to be paid during the next three years.

Converging into Corporations

(For fiscal years ended between 7/1/58 and 6/30/59. All dollar figures in millions. Based on Treasury compilation of income tax returns.)

Type of Business Organization	Number of Companies	Change from Previous Year	Business Receipts	Change from Previous Year	Net Profits	Change from Previous Year	Profits-to-Receipts Ratio	Depreciation
CHEMICALS AND ALLIED PRODUCTS:								
Corporations	8,075	+ 0.6%	22,749.8	— 3.9%	2,589.4	—10.9%	11.4%	967.5
Partnerships	1,141	—39.2%	216.0	—20.6%	18.9	—24.0%	8.8%	4.2
Sole proprietorships	1,289	—53.4%	64.7	+17.0%	8.0	—38.6%	12.4%	1.3
Totals	10,505	—17.1%	23,030.5	— 4.0%	2,616.4	—11.2%	11.4%	973.0
ALL MANUFACTURING INDUSTRIES:								
Corporations	150,696	+ 8.8%	324,134.7	— 1.0%	18,500.5	—18.6%	5.7%	8,529.7
Partnerships	50,745	— 2.2%	8,006.9	— 2.8%	628.2	— 3.0%	7.8%	185.5
Sole proprietorships	179,967	+ 5.6%	6,323.9	+ 1.2%	608.8	+ 6.5%	9.6%	214.8
Totals	381,408	+ 5.7%	338,465.5	— 1.0%	19,737.5	—17.6%	5.8%	8,930.0

Thinning Out the Unincorporated Ranks

The number of unincorporated companies in the chemical industry has been dropping sharply, although there have been increases in numbers of partnerships and sole proprietorships in U.S. business as a whole.

The result, according to the Treasury Dept.'s newest "Business Tax Returns," published last week, is that the corporate form is in a stronger position in the chemical industry than in nearly any other line of business.

Nevertheless, most of the surviving partnerships and sole proprietorships in the chemical industry have been growing and thriving (*table, above*). But, of course, tax laws and other economic factors tend to impel even successful companies of these types to move into the stock-company category, either by incorporating or by selling out to a corporation.

Incentive to Incorporate: In just one year, the number of unincorporated producers of chemicals and allied products shrank by 2,213, while the number of chemical corporations increased by 52.

Probably the biggest single reason for the rise in chemical corporations during the Treasury Dept.'s 1958-'59 fiscal year: addition of subchapter S to chapter 1 of the Internal Revenue Code. Under subchapter S, a domestic corporation with not more than 10 shareholders and only one class of stock may forego payment of corporate income tax if all shareholders agree to pay taxes on corporate profits at the shareholder level. This gives owners of a small business the benefits of incorporation without being subject to both corporate and personal income taxes.

Shoestring Ventures: During that first year in which subchapter S was on the books, 295 chemical companies filed small business corporation tax returns; their combined sales totaled some $90 million. Among those concerns, 172 reported net income aggregating $4 million; the other 123 reported deficits adding up to nearly $1.5 million.

Unincorporated firms made up 23.1% of the number of business entities in the chemical industry in that year. But they accounted for only 1.2% of the industry's sales and just 1.03% of the industry's earnings; and their share of the industry's productive capacity is indicated by the fact that they accounted for only 0.56% of the industry's depreciation.

In manufacturing as a whole, more than 60% of the companies filing income tax returns that year were unincorporated. They accounted for more than 4% of manufacturing sales, more than 6% of profits, and nearly 4.5% of depreciation charge-offs.

Red Ink Entries: Chemical companies operating in the red during that year included 2,504 corporations with net losses totaling $58.1 million, 335 partnerships with deficits of nearly $1.7 million, and 425 sole proprietorships with combined losses of $323,000.

In three other process industries, unincorporated companies are virtually out of the picture. They are so few that they are not itemized in these CPI groups: petroleum refining and related industries, paper and allied products, and rubber and miscellaneous plastics products. Unincorporated concerns make up more than 50% of the roster of producers of stone, clay and glass products, and more than one-third of the companies in the primary metals industry.

Innovations in this latest report include data on depreciation set-asides for all companies, and end-of-year inventory figures for relatively large samplings of companies. Inventory data for the chemicals and allied products industry: 7,060 corporations, $3,519.5 million; 944 active partnerships, $17.1 million; 754 sole proprietorships, $5.1 million.

In the U.S. economy as a whole, the number of business organizations increased by 15% over a five-year period, with unincorporated businesses up 12% and corporations up 42%. Unincorporated companies together accounted for $241.6 billion in business receipts and $28.9 billion in profits; corporations had $696.6 billion in sales and netted $38.5 billion.

national roundup

Rounding out the week's domestic news.

Expansion

Chlorine, Caustic Soda: The industrial development board of Bradley County, Tenn., plans to sell $14.4 million in industrial bonds to finance construction of the chlorine and caustic soda plant being built for Olin Mathieson in Charleston, Tenn. (*CW Business Newsletter, Sept. 3, '60, p. 17*). The plant, with capacity of 180 tons/day of each product, is due onstream early next spring.

Gypsum Products: National Gypsum Co. has started construction of a $1.7-million gypsum building products plant at Port Tampa, Fla. The 270,000-sq. ft. structure is due for completion next summer.

Pulp: Brunswick Pulp & Paper Co. has awarded Stone & Webster Engineering (Boston) the principal construction contract for a $35-million expansion of the company's Brunswick, Ga., facilities. The enlargement, due for completion in January '63, will boost Brunswick's pulp capacity to 1,120 tons/day.

Fine Chemicals: Mallinckrodt Chemicals Works Ltd. (Montreal) is constructing new facilities at Pointe Claire, Que., near Montreal, to house process areas for its fine chemicals production, warehouse space, offices and laboratories. The $500,000 project is due for completion by year's end.

Companies

Kaiser Aluminum & Chemical Corp. (Oakland, Calif.) has sold a $60-million issue of first-mortgage bonds, 5⅜% series due 1991, to a group of institutional investors. One of the principal purchasers was New York Life Insurance Co. Kaiser will use the proceeds to retire its outstanding bank borrowings. Concurrently, the corporation entered into a new bank-credit agreement which provides for loans up to $90 million.

Consolidated Astronautics Inc. (Long Island City, N.Y.) has acquired the rights to processes and equipment for manufacture of air-stable titanium metal powder from United International Research (Newark, N.J.). Consolidated plans to market the powder and other titanium products internationally.

E. L. Bruce Co. (Memphis, Tenn.) will merge with Empire National Corp. (New York) if stockholders, at their Sept. 21 meeting, approve an agreement reached by both boards. The surviving company would be E. L. Bruce Co. Inc. Empire, a holding company, now owns 81.8% of Bruce, manufacturer of hardwood flooring, Terminix brand anti-termite chemicals and other chemical specialties. Merger terms: issue of one Bruce share in exchange for each two Empire shares. There are 314,600 shares of Bruce outstanding, plus 42,785 treasury shares, which would be cancelled.

foreign roundup

Rounding out the week's international news.

Phenol, Acetone/Italy: Gulf Oil (Pittsburgh) and Societa Italiana Resina (SIR) of Milan have joined to form Societa Italiana Resina Gulf, which will construct an $8-million phenol-acetone plant at Porto Torres, Sardinia. Capacity of the plant, due onstream some time next year, will be 70,000 tons/year. SIR holds about 51% of the new company; Gulf, 49%.

Caustic Soda, Chlorine/El Salvador: The president of the Salvadoran Institute for Industrial Development (INSAFOP) has indicated that negotiations are under way for construction of a $4-million chlorine and caustic soda plant in El Salvador. One "foreign firm" will put up $2 million; the other half would be supplied by INSAFOP, other foreign investors, and Central American investors via the Central American Bank in Honduras. Initial daily capacity would be 15 tons of chlorine, 16.8 tons of caustic soda.

Pharmaceuticals, Aluminum/India: The Hungarian government has offered India a $30-million credit to develop its aluminum and pharmaceuticals industries. Hungarian industry representatives are now in India to select a site and provide know-how for a $40-million, state-owned aluminum plant, $16 million of which would come from the Hungarian credits. Capacity would be 25,000 tons/year. The rest of the credit would go toward either another aluminum plant, or a privately owned pharmaceutical industry. Russia is providing the money and know-how required to set up India's state-owned pharmaceutical ventures.

Bauxite/Republic of Guinea: Aluminium Ltd. (Montreal) has suspended work on the $175-million Boke bauxite and alumina plant in the Republic of Guinea. Guinea has been regarded as receptive to Communism, and although observers say they detected a swing back toward the West, it is understood that several potential Western backers are unwilling to lend large amounts until the situation is clarified.

GAULIN TRIPLEX PUMPS

Save "Packing" Failure at High Pressures

Less wear. Even at pressures of 3000 PSI, 2 or 3 Gaulin packing rings *last many times longer* than 7 or 9 rings on other pump designs. Because a Gaulin packing *acts as a seal not a bearing.*

Quick change. It takes less than 15 minutes to change a Gaulin packing, where other makes require up to half a day.

Set and forget. Gaulin's exclusive automatic packing adjustment eliminates human error. Assures uniform packing tension.

No product contact. Equipped with Gaulin's exclusive purge system (not shown above) Gaulin packing is isolated from the product. No part of the plunger contacting the product ever touches the packing. With this system, a Gaulin moves "pressure sensitive", "abrasive", and "toxic" materials at minimum cost—without breakdown or excessive wear.

120 different cylinder designs available to meet every product problem. Capacities from 50 to 7500 GPH...pressures from 500 to 12,000 PSI. *See your Chemical Engineering Catalog for the name of your local Gaulin representative.*

MANTON-

Gaulin

MANUFACTURING CO., INC.
72 Garden Street, Everett 49, Mass.

Washington Newsletter

EMICAL WEEK
ptember 9, 1961

Bills to strengthen the antitrust laws are gaining momentum in Congress. Because of the lateness of the session (Congress hopes to quit before Oct. 1), there is no chance of enactment this year. But some of them will be given priority when Congress reconvenes in January. Generally, they would increase fines and jail sentences for antitrust violations and make corporate officers responsible for the actions of their subordinates. Hearings were held this week before Sen. Estes Kefauver's Antitrust and Monopoly Subcommittee.

Of particular interest is a drive by Attorney General Robert F. Kennedy to give the Justice Dept. subpoena power when checking a possible violation of civil antitrust laws. The Federal Trade Commission already has such authority. Kennedy says that in recent years businessmen have begun refusing to cooperate with Justice in such matters and the situation is "getting steadily worse." Business leaders fear the proposed change would permit Justice to go on "fishing expeditions" among company records.

•

The military stepup in production of conventional ammunition, bombs and missile warheads is becoming evident. Army Ordnance, for example, is hiring 1130 additional production workers at six ammunition arsenals that produce propellants and explosives. Such metal parts as fuses and projectile cases, however, are bought from private industry.

On the last day of August alone, the Army awarded four contracts totaling $20.3 million. These went to Hercules Powder, operating the Radford, Va., Arsenal; Mason & Hangar at the Iowa Ordnance Plant in Burlington; Harvey Aluminum Sales at the Milan Arsenal in Tennessee, and Day-Zimmerman Inc. at the Lone Star Ordnance Plant in Texarkana, Tex. The Army will spend $440 million on ammunition this year, an increase of $160 million over fiscal '61.

•

A long-range study of America's fuel position is about to get under way. Samuel Lasky, an Interior Dept. geologist who has worked on other fuels studies in the past, is gathering a special staff of technicians to put together comprehensive statistics on present and projected supply and demand for coal, oil and natural gas. The study will focus on two problems: How much, if any, protection the domestic fuels industries need from foreign competition, and what changes may be necessary in domestic tax and regulation policies to get the most out of U.S. fuel resources.

The study is expected to take two years. But it will not be nearly as wide in scope as the coal industry had hoped. Congress has allotted only $25,000 for the first year. This all but eliminates the possibility of extensive public hearings and will confine the inquiry to pretty much of a statistical study.

Washington Newsletter

(Continued)

Use of chemicals to reduce evaporation loss in lakes will get another limited test soon in Utah. The Bureau of Reclamation will apply hexadecanol to lakes from an airplane. The nontoxic chemical forms a film about 1-millionth in. thick on the surface of the water and has been used successfully in the past to reduce evaporation.

•

Increased research on viruses as a cause of cancer is indicated by a new move on the part of the National Institute of Health. NIH's National Cancer Institute has created a new virology research resources branch that will provide funds and materials to scientists in the U.S. and abroad working in the virus area of cancer research. Contracts will be awarded by the new branch for development of such research materials as tissue cells, virus detection agents and normal and malignant human tissues.

•

Imposition of federal tolls on the nation's waterways will be the chief subject of discussion at a meeting in Houston, Sept. 20, called by the National Waterways Conference, a group devoted to opposing such tolls. There have been recurring reports that President Kennedy will ask Congress next year to study this issue. Representatives of the chemical, petroleum and other industries that use barge transportation have been invited to the Houston session where conference leaders will solicit their views and support.

•

Lower domestic air freight rates may be forthcoming as a result of the latest action by the Civil Aeronautics Board. Drug and plastics producers are major air shippers (*CW, Aug. 5, p. 147*). CAB revoked, effective Oct. 1, minimum air freight rates that have been in effect for the past 12 years.

The board imposed the minimum originally to halt a threatened rate war. That danger has long since passed, and CAB is convinced that air cargo is about to enter a new era of stability and growth. Big, efficient, jet-powered all-cargo planes are going into operation. With the prospect of lower operating costs and greatly expanded capacity, the board feels the airlines should be given maximum flexibility in setting rates low enough to attract new traffic.

•

The Hanford nuclear reactor may generate electricity after all. A compromise reached by a House-Senate conference committee calls for a single generator (at a cost of $58 million) for the huge reactor. This would generate 400,000 kw. of electric power to be used only at the Atomic Energy Commission installation at Hanford, Wash. The Senate had approved two such generators at a cost of $95 million, but the House twice rejected the whole idea. Rep. James E. Van Zandt (R, Pa.), a member of the conference committee, refused to agree to the compromise and said he would try to get the House to reject it again.

Germany's Big Three

The major splinters of the old I. G. Farben trust account for one-third of West Germany's chemical sales, half its exports. Here's how they have grown, where they are going.

CW Special Report

Germany's Big Three

I. G. Farben: Its Birth, Death . . .

Formed in 1926 from Eight Largest German Chemical Companies

Badische Anilin- & Soda-Fabrik
Friedrich Bayer & Co.
Meister Lucius & Brüning (Hoechst)
AG für Anilinfabrikation (AGFA)

→ **I. G. Farben 1926-1944** ←

Chemische Fabrik Griesheim-Elektron
Weiler-ter Meer
Leopold Cassella & Co.
Kalle & Co.

Allied Occupation— 1945-1951
I. G. Farben

U.S.	U.K.	U.S.S.R.	France

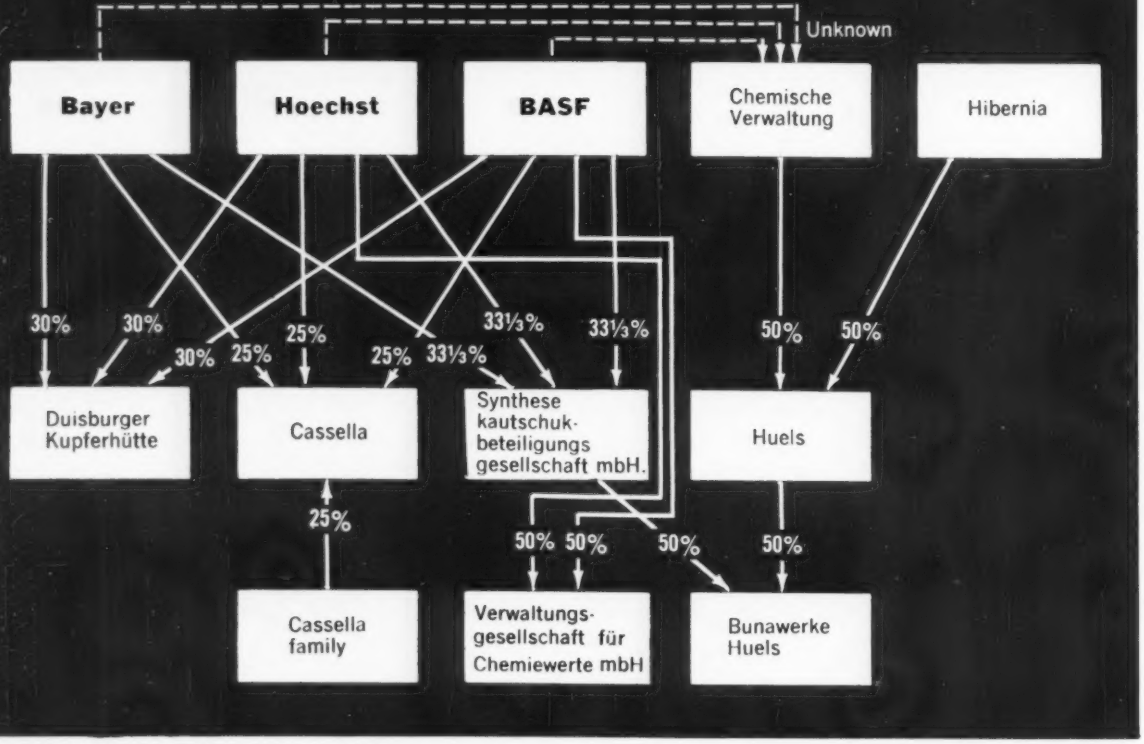
Split Up 1952

Farbenfabriken Bayer AG.	Farbwerke Hoechst AG.	Badische Anilin- & Soda-Fabrik	Chemische Werke Huels GmbH.	Cassella Farbwerke Mainkur AG.
(32%)*	(27%)*	(28%)*	(10%)*	(3%)*

* Capital stock of original I. G. Farben

. . . and Resurrection?

(Known Holdings — 1961)



The Big Three: Up From Postwar Ruin into a Major Chemical Force

"An amoeba gets big and splits into fragments. Then the fragments get big, and they split up too. But with the I. G. Farben splinters, everybody expects it to be the other way around—that the big fragments will recombine."

This is how a top West German chemical executive sums up the puzzle of the three biggest I. G. Farben successor firms, the booming Farbenfabriken Bayer AG. (Leverkusen), Farbwerke Hoechst AG. (Frankfurt-Hoechst) and Badische Anilin-& Soda- Fabrik AG. (Ludwigshaven).

In the post-war decade and a half since they were carved out of the giant Farben chemical empire, the Big Three have made a spectacular comeback. Farben's best sales figure was $750 million (at today's exchange rate), scored in '43. Today, each of the Big Three is fast approaching that level on its own. In '60, Bayer's sales were $670.8 million, Hoechst's $643.3 million, BASF's $615.9 million.

When the three companies were freed by the Allied occupation authorities in '52, they had been squeezed through the grinder of wartime destruction, post-war dismantling, denazification and dispersal. That year, their combined sales accounted for 25% of the West German chemical industry's total.

Since then, the West German industry's growth has been breathtaking. Sales have more than quintupled, production increased by more than 350%. Germany is no longer the predominant master of the world chemical industry, but it's running neck and neck with Britain for third place (behind the U.S., Russia) in a much larger worldwide chemical industry than existed before WW II.

And the Farben successors have paced this growth. Last year, they accounted for 35% of the West German chemical industry's sales, 50% of its exports, 60% of its capital spending. This year, they will almost surely account for 40% of total sales. And with their investments expected to run nearly 15% of gross turnover for the next few years, no insider would bet against the Big Three's writing up 50% of West Germany's total chemical sales and two-thirds of its exports before the end of this decade.

To an increasing extent, then, as the Big Three go, so goes the West German chemical industry.

Up from the Rubble: Between the lines of this record, many observers see signs of the rebirth of the old I. G. Farben empire. Certainly, a great share of the credit for the Big Three's increasing dominance must go to aggressive and efficient Farben-trained management men. But it would be totally naive not to realize that at least some credit must also go to the considerable degree of reconcentration that has been going on in the German chemical industry—and the Farben companies in particular—since the war.

The Farben combine was confiscated by the wartime Allies as enemy property at war's end. Its top management were branded war criminals. They had actively abetted Hitler's war machine, used slave labor under terrifyingly inhuman conditions to keep the Farben plants running full blast. Most of them were acquitted of the charges at the Nurenberg war-crimes tribunal. But at least a half-dozen former Farben executives drew prison sentences for their part in the Third Reich.

About half of Farben's domestic holdings lay in Germany's eastern territories, and thus fell into the hands of the Soviets. Today they form the basis of East Germany's solid chemical industry. And, thanks to the pillaging of equipment and know-how by the Russians, they have helped the Soviet Union establish its strong CPI.

Split up: The other half of Farben's domestic holdings were cut up among the three Western allies. The U.S. got what is today Hoechst. Bayer went to Britain, BASF to France.

From '45 to '51, the Allies wrestled with the problem of what to do with this empire. No one was very happy about Farben and the Germans at the time, of course, and there was a strong feeling that it should be chopped up into many small segments and dispersed, so that no such concentration of chemical power could ever recur. One strongly-backed proposal was to split it into 43 independent firms. This would have involved making companies out of individual plants, and splitting the big complexes down the middle.

The German chemical producers battled these proposals vigorously. They argued—with considerable justification—that such a splintering would wreck the industry. Farben had been thoroughly integrated in its heyday, both in its operations and in its management. To a very large extent, no one facility could function without all the others. One plant made raw materials, another produced process steam and power, etc., while the group used common railroad sidings, warehouses, packaging, and shipping facilities.

Needed Friend: With the outbreak of the Korean war, Allied policy on Germany shifted sharply. Germany was no longer an enemy; it had become—potentially, at least—a powerful cold-war ally. The Allies decided the Germans ought to have a solid base on

which to rebuild their depleted chemical prowess.

Instead of being subjected to minute fragmentation, Farben was broken up into five major segments—the Big Three, plus Chemische Werke Huels GmbH. (Marls) and Cassella Farbwerke Mainkur AG. (Frankfurt-Mainkur.) Bayer received about $90 million of Farben capital stock, BASF $80 million, Hoechst $70 million, Huels $30 million, and Cassella $8 million.

Generally speaking, the decision satisfied all parties. There was, and still is today, a slight amount of grumbling over Huels. Huels had been created during the I. G. Farben days as a model experiment in modern chemical processing, especially petrochemical operations. Farben sank a great amount of research and development money into Huels, carrying its steady losses in the hope of eventually benefitting from the advanced technology developed there. To a degree the other Farben successors felt they had been cheated out of their investment about the time the firm promised to pay out.

Even Start: The Big Three, in '52, started out on the recovery road pretty much on an equal footing. The management of each company had been chosen by its respective Allied occupation authorities. The Americans picked Karl Winnacker, a former plant manager for Hoechst, to manage their holdings. Ulrich Haberland, also a works manager—for Bayer at Leverkusen —was named by the British. Carl Wurster had been the boss of BASF's Ludwigshaven facility during the war, and got the job back from the French when he was acquitted by the Nurenburg court. When the companies were established as publicly owned shareholding companies, the three became their presidents. And the management team picked by the Allies from other talented former-Farben second-level executives became the companies' staff of vice-presidents and lower-rung executives.

Hoechst, in a sense, was set up as a sort of holding company. It received 100% holdings in such important former Farben companies as Knapsackgriesheim, Kalle, and Behringwerke. In addition, it received 77.5% of the stock of Friedrich Uhde, an engineering firm, and a 50% interest in Wacker Chemie. Together with these, Hoechst had the plants of Farben's former Rhein-Main area at Frankfurt—Hoechst, Gersthofen, Offenbach, Bobingen, and Marburg.

Bayer and BASF, by and large, were given back their old operations. Bayer consisted chiefly of the facilities of Leverkusen, Elberfeld and Uerdingen; BASF of the massive facility at Ludwigshaven. In addition, Bayer received Afga AG., the photochemical company.

Mutual Attraction: In the 15 years that have followed, all three firms have added strongly to their holdings. And many of these additions have taken place in concert, raising the charge of reconcentration.

The Big Three, for example, have bought 75% of Cassella, the fifth Farben successor. Each holds 25%, while the rest is in the hands of the Cassella family and public shareholders.

Moreover, the Big Three, insiders believe, have gathered into their hands not inconsiderable numbers of shares in the fourth Farben successor, Huels. Huels is owned 50-50 by Hibernia, a government-held coal mining company. and by a holding company called Chemische Verwaltung. There are complicated tieups between the Big Three and Hibernia, and the companies are said to have substantial shares in Verwaltung, though this is not officially acknowledged. In any event, the Three control 50% of Huel's major subsidiary, Bunawerke Huels, through their holding company, Synthesekautchuk, which was set up to administer their interest. Bunawerke went onstream in '58.

And the three are teamed in other German companies. Each, for example, holds a third of Duisburger Kupferhuette, a producer of iron ore and pyrites. And Hoechst and BASF jointly own Verwaltungsgesellschaft fur Chemiewerte, which in turns holds 30% of Sueddeutsche Kalkstickstoff-werke AG.

Spreading Out: Each of the Big Three has also picked up new interests independently in the years since the breakup. BASF, for instance, owns 100% of Auguste Victoria, a coal mining company, 46% of Chemische Fabrik Holten, and 50% of Rheinische Olefinwerke, petrochemical producers. Bayer has 100% ownership in firms like Haarmann & Reimer, organics producer, Fluss- & Schwerspatwerke Pforzheim, fluorite manufacturer, Gewerkschaft des Steinkohlenbergwerks Neu Mecklingsbank, coal producers; 50% interest in Erdoel Chemie, petrochemical manufacturer, etc. Hoechst has picked up 60% interest in Spinstoffabrik Zehlendorf, a synthetic fiber spinner, 100% in Gebr. Wandesleben, a chalk producer, etc.

Altogether, the Three each have major or minor interests in dozens of firms, within Germany and abroad.

Growing Too Big? Nevertheless, any charge that the Big Three unduly dominate their country's chemical industry and are headed down the road towards a Farben-like cartelization has to be tempered by certain facts.

There are in West Germany today at least 5,000 chemical producers of one sort or another. Of these, at least 250 can boast annual sales of more than $2 million. While the Big Three get 35% of total sales,

Germany's Big Three

DRAWINGS BY RICHARD P. KLUGA

Karl Winnacker heads Farbwerke Hoechst. Last year his company nudged up to second place in German chemical sales. Though it's least active of the Three internationally, Hoechst does have several U.S. operations.

Carl Wurster is BASF's Chairman of the Board of Supervisors (equivalent to president of a U.S. corporation). Like the heads of the other two big Farben successors, he was picked by the Allies for the job, had been a works manager.

there are 80 relatively independent firms that account for the next 25%.

In this perspective, Bayer, Hoechst, and BASF actually don't overshadow their country's chemical industry a great deal more than a comparable handful of firms in other countries overshadow theirs. This is especially true when you compare the situation in Germany with that in Italy and France, where a smaller group of chemical giants account for a greater share of sales. The same can even be said of Britain with its powerful Imperial Chemical Industries.

"And, after all," asks one Big Three executive, "when you take into consideration the much greater size of your market, isn't it a similar handful of companies that dominate the American chemical business?" He adds, "I think it should be easy enough to understand that, in terms of modern chemical technology, it requires big companies with big plants and a lot of money to invest and spend on research to make chemicals today."

Why Recombine? If there are good reasons why the Big Three are as big as they are today, there are also good reasons why the possibility of their recombining or even of swallowing Huels is virtually nil. For one thing, there's the powerful factor of public opinion—if not in Germany, then in the rest of the world—working against it. The Big Three, with their heavy stake in world markets, acknowledge that they are extremely sensitive to this.

And there are stronger reasons. As one executive puts it, "In this business there's such a thing as a minimum and maximum size for efficient operation." Many former Farben men claim that shortly before the outbreak of WW II, I. G. Farben was seriously thinking of voluntarily breaking itself up because it had become too big. Says one, "We had lost control over all our parts. We were getting sloppy and inefficient because we really didn't know what each part of the company was doing. Certain branches were making commitments or entering into activities that contradicted what other

branches were doing. And we couldn't find out really until it was too late. We were losing flexibility at the same time. To avoid doing contradictory things, we had to take too long to decide to do anything at all."

None of the Big Three would say that at their present size they have already reached this point of diminishing returns. But they do argue that by tripling their size overnight—which is what recombination would mean—they would.

The Big Three also assert that competition ("at least, a little competition," amends a smiling company vice-president) is a good thing. "It keeps us on our toes and forces us into new fields of research, development, and production."

Uncut Throats: All this doesn't mean that the Big Three are conscientiously cutting each others' throats. Besides their joint ventures at home and abroad, Bayer, Hoechst, and BASF cooperate to some extent in their over-all operations. Superficially, all three produce the full range of chemical products—plastics, synthetic fibers and films, solvents, paints, dyes, textile chemicals, organic intermediates, pharmaceuticals, fertilizers, pesticides and insecticides, various inorganic and heavy chemicals.. But a closer study of their catalogues shows that product-to-product competition on the open market is actually rather limited.

There's no question that each firm competitively makes a full range of the chemicals it consumes itself, such as sulfuric acid, various organic intermediates, and solvents. But when it comes to products sold competitively on world markets, you find that one Bayer dye or pharmaceutical is not exactly the same as Hoechst's or BASF's—isn't intended for exactly the same application, and so doesn't compete with them.

There are exceptions, of course—in agricultural chemicals, for instance. But the notable exceptions could be classified as the modern chemicals, developed in the last five years or so. The petroleum-based products such as the newer synthetic fibers and plastics are in this class.

Heritage: There's a sound explanation for this situation, beyond the one that the Big Three prefer staying out of each others' way on the market place. During the old Farben days, the various segments of the cartel were extremely "rationalized" both in their production and marketing activities. Bayer made all the pharmaceuticals. Part of the Rhein/Main group (under Hoechst today) concentrated on heavy, basic chemicals. BASF made certain dyes and textile chemicals, while Bayer and Hoechst made others.

This heritage has naturally carried over to the present Big Three. The equipment, the production and marketing know-how, and the personnel at each firm directly after the war was based on what had been done at the facility previous to the Allied occupation.

But as the Farben-successors began branching out into new fields of chemistry and chemical engineering, each started from scratch. Research, development and engineering were to a great degree competitive. And so were the efforts to grab a solid share of new, growing markets. This has been especially true in the new synthetic fibers and plastics. Here the Big Three were starting out completely fresh. After a century's tradition

Ulrich Haberland, as president of Farbenfabriken Bayer, heads West Germany's largest chemical company. It's also the most active internationally, with extensive foreign operations, large exports.

Germany's Big Three

of basing chemical production on coal, they were on the brink of the revolutionary shift to petrochemistry.

Switch to Oil: It is, unquestionably, the shift from coal to an oil and natural gas raw material base that characterizes the Big Three, technologically and from a business viewpoint, as they head into the future. Not surprisingly, their activity in this area (as in others) is reflected throughout the West German chemical industry.

At the war's end, the West German CPI had virtually no commercial petrochemical operations worth mentioning. As recently as '57, German chemical makers produced less than 160,000 tons/year (in terms of carbon content) of products based on petroleum or natural gas feedstocks. By last year, however, production had rocketed to over 600,000 tons, making Germany the largest petrochemical producer in Europe, edging out Britain for the first time. This year production will reach 1 million tons, and will push to 1.2 million tons in '62. Nearly half of Germany's total organic chemical production today stems from petroleum or natural gas. And industry sources predict that this proportion will reach 75% by the end of the decade. Petrochemical production in Germany today is a $1-billion/year business.

The Big Three have paced this boom. It's estimated by reliable industry observers that in the last 3-5 years Bayer, Hoechst and BASF have been allocating upwards of 60% of their capital investment expenditures either directly or indirectly for research, development, expansion, and modernization of petrochemical facilities.

In Germany, virtually all crude oil and most natural gas must be imported. The Big Three are taking two slightly different routes to solve the feedstock source problem.

Hoechst prefers by and large to go it alone. It buys its raw material from an oil company and processes it in its own plants. Take Hoechst's recent deal with Caltex. The German subsidiary of this U.S. oil company plans to build a $50-million, 2-million-tons/year refinery just down the Main river from Hoechst's large petrochemical complex near Frankfurt.

Hoechst sold Caltex on the project by buying the 495-acre tract and subletting to Caltex at reasonable rates, signing a long-term contract for purchasing a major share of the refinery's light petroleum gas output and, some insiders believe, helping out in financing the project.

Hoechst needed the refinery there in order to bring off a major petrochemical expansion on the site. (The company, which is presently processing 350,000 tons/-year of benzene and olefins there, expects this figure to double, perhaps triple, by '65). But Hoechst did not offer to get into any petrochemical partnership with Caltex.

BASF and Bayer, on the other hand, have chosen the joint-venture route to securing feedstock. Bayer, for example, joined British Petroleum to form Erdoel Chemie on a 50-50 partnership basis. The offspring runs a petrochemical plant at Dormagen, supplied by BP's nearby Dinslaken refinery. BASF, similarly, teamed with Deutsche Shell in Rheinische Olefinwerke, at Wesseling, where Shell has one of its major German refineries.

But when it comes to petrochemical processes, all three firms are quite willing to mix three business approaches: developing their own, licensing from others, engaging in joint ventures with foreign firms. Hoechst, for example, has formed Bobina Faser Werke with Celanese to produce polyacrilonitrile fiber. BASF has licensed ICI's high-pressure polyethylene and Phillips' low-pressure polyethylene processes.

Economic as well as technological reasons lie behind the coal-to-oil switch. Despite the fact that it is more abundant in Germany than either oil or gas—coal has become the less economic raw material not only from the processing point of view, but in price as well.

Germany's rich coal deposits, worked for generations, are now productive only at very costly depths. Most of Germany's newer and more easily accessible coal mines lie in the Communist East. As a result, coal is more than four times as expensive as it was before the war. And steel production, to which coal output is tied, is not climbing fast enough to keep up with the chemical industry's needs.

Oil, meanwhile, has been flooding into the country. The major international oil companies and the German independents have built refinery capacity to nearly 45 million tons/year in Germany. Pipeline projects to bring oil in are springing up everywhere. One, from Wilhelmshaven to the Ruhr, has already been built. Another, from Rotterdam to Cologne, is now also completed. And plans are being hatched for Marseilles-to-Karlsruhe and Genoa-to-Ingolstadt lines. Deep-sea ports, such as Hamburg's, are being expanded to accommodate more and larger oil tankers.

Leveling Off: The Big Three's push into petrochemicals is coming at a time when they and the rest of the German chemical industry are seeing their decade-and-a-half of brilliant business weather showing the first disconcerting signs of clouding over. This is not pure coincidence. The shift to a petroleum raw material base is a vital part of the industry's efforts to cope with the problems that lie ahead.

Some of those problems are suggested by statistics

such as these: While last year's $5.5 billion sales were up 12% over '59, sales this year are expected to rise only about 6%. Exports posted a 14% gain in '60; this year they too are running only 6% ahead of last year. Meanwhile, chemical imports to Germany are climbing at a stunning rate, due to exploding demand, some domestic shortages, lower trade barriers, and harder sales efforts by foreign producers. Total chemical imports rose 32%, to $660.7 million. Imports from the U.S. alone shot up 40%, to $197.6 million. The greatest gains were in industrial chemicals, especially inorganics which were up 59%. Industrial organics rose 40%.

Then too, there's the fact that chemical prices keep steadily, if moderately, sliding, while the prices for most German goods are inching up. Thus costs, and especially wages (up nearly 14% in the chemical industry last year) are beginning to put the first noticeable squeeze on the Big Three's usually handsome profits, which are said to run between 20-35% of turnover, before taxes.

Pressure from U.S.: Most of the troubles moving in on the Big Three, company executives say, can be laid at the door of steadily stiffening foreign competition, especially from the U.S. and Britain.

The spectacular development of the Common Market, as well as EFTA, is proving increasingly attractive to expansion-minded chemical producers in both these nations. And the prospects that the EEC and EFTA will eventually merge adds to the attractiveness of Germany's market "preserve."

German chemical executives have never been shy about accusing U.S. chemical makers of dumping goods at market-breaking prices. And though they'll repeat this charge with heat—especially concerning recent price developments in polyethylene—they are finding that they are not faced merely with dumping. Says one Big Three executive, "The American chemical industry, long notoriously provincial about international trade, is actually becoming export conscious" (*CW, Nov. 26, '60, p. 109*).

But that's not the worst of it, say the Big Three. U.S. chemical firms during the last three years have invested about $250 million in Europe. Chemical plants in Europe owned by U.S. firms had an estimated turnover of more than $1 billion in '59; since then a lot more capacity has been coming onstream. And investments continue to pour in.

Moreover, the British, always export conscious, are pushing ever harder these days. ICI's $280-million investment program for Rotterdam, Courtaulds' new French fiber plant, and Laporte's recent purchase of Germany's Elektrochemische Werke Muenchen are

How the Big Three Stacked Up 1960

	Bayer	Hoechst	BASF
Sales ($ million)	670.8[1]	643.3[2]	615.9[3]
Increase over '59	14.6%	21.7%	14.1%
Share of Market	11.9%	11.7%	11.4%
Export ($ million)	300.7	210.4	—
Percent of sales	45%	33%	37%
Investment ($ million)	96.2	100.4	98.8
Sales/employee ($ '000)	11.8	13.4	13.4

Conversion rate: 1 DM=$0.238

1. For Bayer and wholly owned domestic subsidiaries. $785.4 if Bayer's portion of foreign subsidiary sales is included.
2. Does not include $66.6 million sold by Wacker-Chemie or $64.3 million sales of foreign subsidiaries in which Hoechst holds 50% or more.
3. Includes outside sales of wholly owned domestic subsidiaries and of partly owned domestic companies whose products sold through BASF organization.

Major Holdings of the Big Three*

Bayer

Haarmann & Reimer GmbH. 100%
AGFA AG. 100%
Fuss- & Schwerspatwerke Pforzhein GmbH. 100%
Gewerkschaft des Steinkohlenbergwerks GmbH.
Erdölchemie GmbH. 50% (with British Petroleum)
Mobay Chemical 50% (with Monsanto)
Progil-Bayer-Ugine 33% (with Progil and Ugine)

BASF

Gewerkschaft Auguste Victoria 100%
Rheinische Olefinwerke GmbH. 50% (with Shell)
Dow Badische Chemical Co. 50% (with Dow)
Dispersions Plastiques SA 50% (with Dispersions Plastiques)
Verwalbingsgesellschaft für Chemiewerte mbH. 50% (with Hoechst)
Chemische Fabrik Holten GmbH. 46% (with various interests)

Hoechst

Knapsack-Griesheim AG. 100%
Gebr. Wandesleben GmbH. 100%
Kalle AG. 100%
Behringwerke AG. 100%
Freidrich Uhde GmbH. 77.5% (with Uhde family)
Wacker-Chemie GmbH. 50% (with Wacker family)
Spinnstoffabrik Zehlendorf AG. 60% (with diversified interests)
Verwaltungsgesellschaft für Chemiewerte mbH. 50% (with BASF)
Sigri-Kohlefabrikate GmbH. 50% (with Siemens)

*Holdings in Bunawerke Huels, Duisburger Kupferhütte, Cassella and many smaller companies and minority shares in large companies not listed.

good examples of their new vigor.

While German producers favor it because it will give them greater opportunities, the prospective entry of Britain and some of its Free Trade Assn. partners into the Common Market can be expected to intensify the Big Three competition problems. Britain, for example, will have the advantage of a better labor supply. Switzerland won't actually join the Common Market, but it will probably work out a free trade scheme with it, strengthening its potent position in fine chemicals.

In addition to this competition from "outside," the Big Three have to sell against other chemical companies throughout the Continent, which, like themselves, have been strengthened by the European economic boom. Some of these, like the French, have been increasingly hungry for foreign markets to ensure operation on an efficient and profitable level. Others, such as the major Italian producers, can compete with the Germans with such advantages as lower labor costs and considerable government assistance.

Moreover, nations that never had significant chemical industries, such as Austria and the Scandinavian countries, are getting into the business. India and the United Arab Republic are other new chemical makers outside of Europe which have in the past been good customers of the Big Three, but which will be increasingly self-sufficient.

Bag of Problems: Foreign competition is only one of the problems facing the Farben successors. Probably the most severe is Germany's acute labor shortage—the unemployment rate is a rock-bottom 0.05%. The result has been the first major upward drive in German wages since the war's end. More important, the labor shortage is a crucial bottleneck to expansion. This means a loss of potential sales growth. Troublesome, too, is the relatively tight money market. Designed to combat the inflationary trend, the money policy also has the effect of limiting expansion. And not only must chemical makers invest in order to expand to profitable working capacities; they face an unusually high rate of obsolescence because of the industry's rapidly advancing technology.

Moreover, Bonn's recent D-mark revaluation of 5% hurt German chemical companies more than most others because of the chemical makers' heavy stake in exports. By making goods more expensive in world markets without increasing real revenues, the "harder" mark sliced sharply into the industry's vital export business. And cheapened imports hurt the Germans at home. To top it off, the revaluation has prevented the industry from raising real prices—even if it dared to in the face of stiffening competition—to help ease the squeeze on profits.

Ways Out: Big Three executives see some answers to their developing problems in the coal-to-oil shift, which puts them in a position to compete with U.S. and British companies with the most advanced plastics and fibers, for example. And it makes their operations more economic in some of the older areas of chemical processing.

And they are trying to find a way out of their labor bind. "Imports" are one answer. Of Bayer's 59,000 employees, more than 2,000 come from outside the country; BASF's work force of 47,000 includes nearly 1,000 foreigners. Even Hoechst has imported nearly 1,300 foreign workmen to supplement its 50,000-man force, although it is less pinched than the other two because some of its major operations are in Bavaria, which is still not as labor short as the rest of Germany. But this approach is clearly tentative, since labor is tight in much of Europe. Moreover, bringing in foreign labor raises problems of language, training, and assimilation.

So the Farben successors are turning to the idea of expanding in less labor-short areas abroad. Bayer's recent decision to build a major chemical complex at Antwerp was motivated largely by the labor supply factor.

Another strong reason for building abroad: to put down firmer roots in foreign markets. Probably the most striking illustrations of such moves are Bayer's tieup with Monsanto in Mobay Chemical, and BASF's with Dow in Dow Badische.

Bayer's foreign operations are the most extensive of the Three. It has subsidiaries in Mexico, Brazil, Argentina, South Africa, Pakistan, India and Japan, as well as in the U.S. BASF has ventures in France, Brazil, and Argentina. Hoechst's foreign operations have been less ambitious than the other two—primarily small specialty dye makers and pharmaceutical finishers and packagers in Brazil and the U.S. (*CW, June 18, '60, p. 89*).

U.S. producers can expect more and more competition from the Big Three both in the U.S. and third markets. But for all this overseas expansion, and despite the problems they face, the Farben successors will surely continue growing strongest on the European continent, where their position is most strategic and their opportunity is greatest.

Reprints of this report will be available for $1 each. Bulk rates on request. Write Chemical Week, Reprint Dept., Room 1200, 330 West 42nd Street, New York 36, N.Y.

NEWS FROM AO

R-5091P respirator is shown in combination with 701 goggles. R-5051P respirator is also available.

New safety for paint spray operators

Just approved by the U.S. Bureau of Mines . . . this new AO paint spray respirator protects against sprays and vapors of enamels, lacquers and lead-based paints. If you're now using any of the AO R-5000 series respirators, you don't need a new face mask, not even a conversion kit. Just replace the cartridges with either of two approved new units, and get maximum protection.

This new AO paint spray respirator is compact, light in weight, combines maximum efficiency and service life with ease of maintenance. It is one of 17 combinations possible with the R-5000 series. By simply interchanging filter units in one basic face piece you protect against a range of hazards, including mercury vapors, highly toxic insecticide and radioactive dusts.

For further information on any R-5000 respirator model, contact your nearest AO Safety Products Representative, or write for folder S-1297.

Your Surest Protection . . . AO SURE-GUARD Respirators

American Optical
COMPANY

SAFETY PRODUCTS DIVISION • SOUTHBRIDGE, MASSACHUSETTS

BASIC PRODUCERS OF FATTY ACIDS • GLYCERIDES • FATTY NITROGEN DERIVATIVES

Improved water repellency with a new Behenamide

The customary stearamides for textile water-proofing formulas have presented two serious problems... poor color and poor color stability. Because of unique fatty acid producing facilities and versatile amide processing, HumKo was able to produce a stearamide (KEMSTRENE AMIDE S) with superior color and improved water repelling characteristics. Now HumKo has developed a new Behenamide (KEMSTRENE AMIDE B) which has retained all the advantages of the HumKo stearamide, plus dramatically improved initial and continuing water repellency.

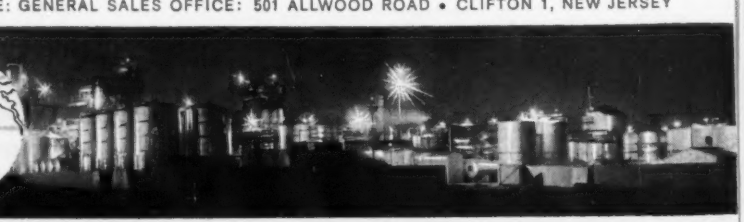
This advancement in textile water repellency suggests the same principles can apply in formulations for insolubilized paper coatings.

KEMSTRENE AMIDE S and KEMSTRENE AMIDE B are two of a series of new free-flowing powdered amides whose physical form may suggest processing or new product advantages to other amide consumers. Samples are available. Call or write us... we would like to work with you.

WRITE: GENERAL SALES OFFICE: 501 ALLWOOD ROAD • CLIFTON 1, NEW JERSEY

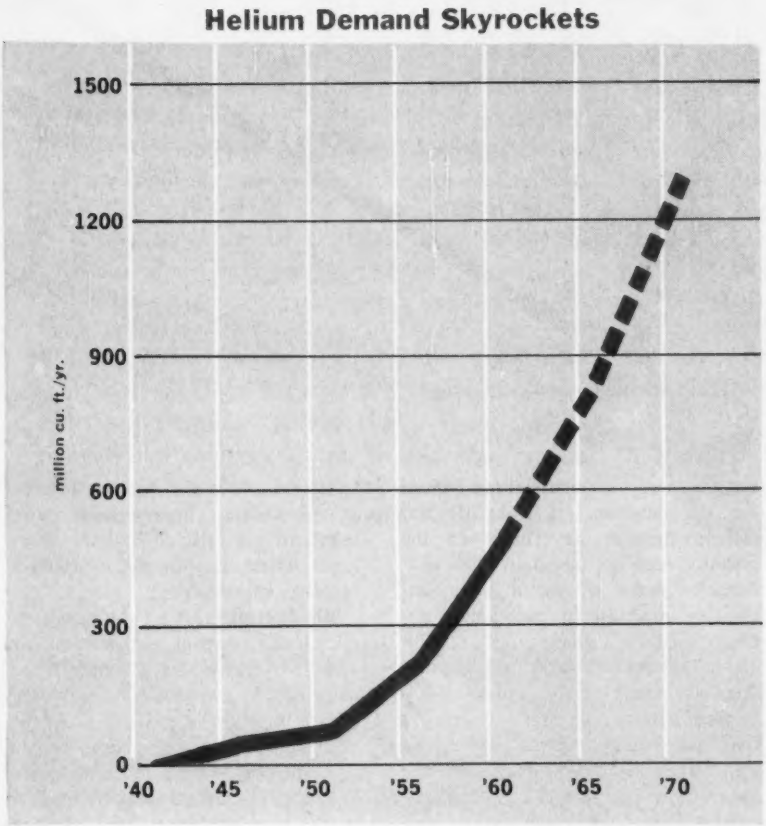
idening
ur world
achievement
ith chemicals
rived from fats

HUMKO
PRODUCTS
CHEMICAL DIVISION



IN OFFICE: MEMPHIS • TENNESSEE

DIVISION OF NATIONAL DAIRY PRODUCTS CORPORATION



Relieving the Helium Bind

Skyrocketing demand for helium—from 81 million cu.ft. in '50 to 522 million in '60—for defense and industrial uses is behind the government's signing, last week, of the second of the new purchase contracts with companies set up to recover helium (CW Market Newsletter, Sept. 9). The contracts—12 are planned—will make it possible to recover about one-third of the Western world's available helium. But helium users—both federal and private—will be paying double the unit cost for helium produced in this conservation program.

The U.S. Bureau of Mines is now the sole processor and producer of helium in the nation. It's now selling almost all it can turn out at its five plants—about 684 million cu. ft/year. Equipment modification to allow use of richer feedstocks might boost the capacity and this is now under consideration, although immediate action isn't planned.

Under Way: The first of the privately financed, constructed and owned helium extraction plants will be built at Bushton, Kan., by the Helex Co., a subsidiary of Northern Natural Gas Co. (Omaha, Neb.). It will be able to process 170 billion cu. ft./year of natural gas and recover 90% of the helium contained (average helium content 0.46-1%). The "raw" helium produced will consist of 60% helium and 40% nitrogen. The USBM will pay $11.24/1,000 cu. ft. for all helium produced in the plant —up to a maximum of $9.5 million/-year (USBM will pay for the helium content only) for 22 years. Start-up date: no later than Jan. '62.

The second facility will be built at Ulysses, Kan., by Cities Service Helex, Inc., a wholly owned subsidiary of Cities Service Co. (New York). It will process 505 million cu. ft./day of natural gas (average helium content 0.45%) to produce 700 million cu. ft./year of helium. USBM will pay $11.78/1,000 cu.ft. for the helium—up to a maximum of $9.1 million/year for 22 years. Expected start-up date: early '63.

Other contenders for contracts are Helium Conservation Corp. (Midland, Texas) and Panhandle Eastern Pipe Line Co. (Kansas City, Mo.). Ten additional offers from companies have also been made.

Higher and Higher: Helium is becoming increasingly important to the nation's missile and defense programs. Prior to and during W W II helium was used almost exclusively as a lifting gas for lighter-than-air ships. Consumption in '40 amounted to only 8 million cu.ft. However, through the development of new uses—both defense and industrial—consumption increased to 81 million cu.ft. in '50 and soared to 522 million cu.ft. in '60. Demand will be increasing at the rate of 10-15%/year and it is expected that by '65 860 million cu.ft./year will be consumed, and the rate will be 1.3 billion cu.ft. by '70.

About 110 million cu.ft./year of helium is now being used in missile applications. It is pumped (as a liquid) into the liquid oxygen tanks—as the oxygen is used, the helium expands, filling in the space formerly occupied by the oxygen. It provides the strength and rigidity needed by missiles (big missiles are virtually nothing but fuel tanks, with small motors and warheads).

Helium is also widely employed in shock-tube tests, so that missile performance at velocities in excess of 10,000 miles/hour can be charted. A new development: possibility of using the inert gas to improve power of space vehicles. It has been found that helium has the ability to "contain" free radicals. These free radicals, when released, give a tremendous burst of energy and would increase the power and thrust of space capsules (*see p. 105*). It is expected that demand for missile applications will reach 200 million cu. ft. of helium by '65.

Leak Detection: All of the major

World-wide, industry-wide users say:
"Cowles Dissolver® equipment makes a BIG difference"

If your processing requires dispersion, deagglomeration, mixing or dissolving, the comments of Cowles users all over the free world may point the way to substantial advantages for you. Here are a few of hundreds in our files from some 72 countries—

ENGLAND
". . . extraordinary good results with these pigments . . . using our micronized Red Oxide obtained a reading of 8¾ on the P.C. (1-10) Scale in 10 minutes . . . with our Leadchrome/-Prussian Bluegreen obtained 8¼ in 5 minutes."

GERMANY
"With the Cowles we obtain the best wetting out within shortest time. This makes it possible for us to save on mill passes. Because of this the machine has proven to be absolutely invaluable to us."

ITALY
". . . by using the Cowles as premixer we are saving 2 passes out of 3 on the 3-roller mill."

DENMARK
". . . Certain products which need roller milling when using traditional mixing methods, can now be produced directly on the Cowles, without roller milling."

COLOMBIA
"Your equipment has provided us with such excellent results that we want immediately to obtain additional Dissolvers . . . "

SPAIN
"The Cowles Dissolver which we bought has given us magnificent results."

JAPAN
"Your equipment works very satisfactorily . . . It will give high production with the added advantage of easy cleaning and quick change-over."

The high-speed, high-shear principle of the "COWLES DISSOLVER" design, plus the unique transmission system that is capable of delivering over 90% of motor power to the patented impeller, can help you save money, time and space.

Let us prove it in your plant—at our risk! Write today for more complete information.

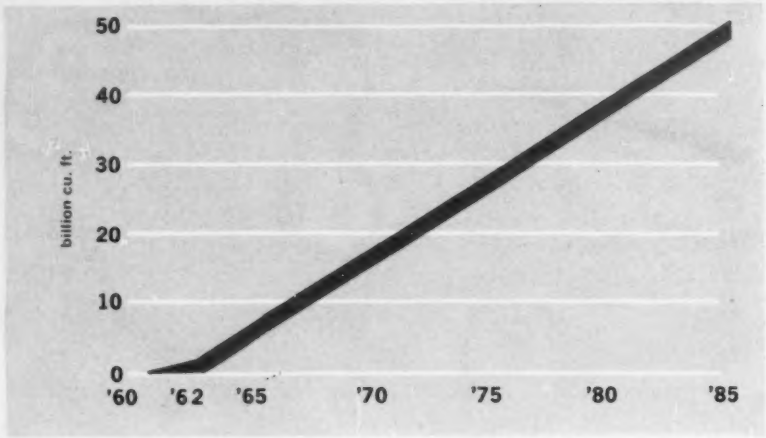
MOREHOUSE—COWLES, INC.
1150 San Fernando Road, Los Angeles 65, Calif.

MOREHOUSE COWLES

Representatives in Principal Cities. Convenient Lease and Time-Payment Plans.

Please send me information on use of "COWLES DISSOLVER" mixers in processing (product)
.....
Name ..... Title .....
Firm .....
Address .....
City ..... Zone ..... State .....
426

Government Helium Stockpiling Plans



atomic energy installations use helium for the detection of leaks (it will diffuse through any flaws in the system). Also, its unusually high heat capacity makes it useful as a circulating medium in gas-cooled nuclear reactors. These uses require about 100 million cu.ft./year of helium. Demand for '65 will probably be near 140 million cu.ft.

In arc-welding, helium is used as an inert gaseous shield around the electrode to permit welding of aluminum, copper, titanium, magnesium and stainless steel without the necessity of extensive pretreatment or flux. It is also an excellent conductor of heat and electricity. Some 92 million cu.ft. of helium is now used in this application and it is expected that its yearly use will increase to 120 million cu. ft. by '65.

About 70 million cu. ft. of helium is used in meteorology and aerology—to fill balloons that are sent into the upper air to help collect data on weather, air currents, cosmic activity, etc. Continued research and study along these lines is expected to up its use to 90 million cu. ft. in '65.

Wind-tunnel research to study the effect of plane and missile design at hypervelocities is consuming 40 million cu. ft./year of helium. By '65 this will increase to 80 million cu. ft.

Miscellaneous applications required almost 100 million cu. ft. in '60. Such uses include 'neon" lighting, toy balloons, and as an admixture with oxygen to ease the breathing of asthma and lung congestion victims and with anesthetics to reduce the danger of explosions. It is also used as a tracer in determining underground movements of gas injected into oil or gas fields. These uses are not expected to increase appreciably.

Big Potential: Of all the newer applications, however, cryogenics, the study of the behavior of materials at temperatures approaching absolute zero (—459 F), appears to have the greatest growth potential. For instance, some metals become superconductors at low temperatures and this has led to the development of the cryoton, which performs the functions of transistors and vacuum tubes.

MASER (microwave amplification by stimulated emission of radiation) and other low noise amplifiers, which operate in baths of liquid helium, can produce about 1,000 times the amplification that conventional systems can. The increased sensitivity will become increasingly important in ultrahigh frequency communications, radar and radio astronomy. It is envisioned that the nonfederal cryogenic uses for helium alone will increase to 250 million cu. ft./year by '65.

Price Hike: The USBM claims that the imminent price increase of helium, from $19 to $35/1,000 cu. ft., is necessary because it will provide funds to purchase helium for stockpiling and therefore assure users an adequate supply and guarantee a reserve supply of the gas.

In the 40 years the USBM has been producing helium it has created a large natural underground storage tank. In the Amarillo, Tex., area alone there is storage capacity for 32

FROM **CARBIDE'S** SOLVENT CENTER...

The widest range of glycol-ethers... 11 CELLOSOLVE and CARBITOL solvents

Glycol-ethers are excellent solvents for... lacquers, varnishes and enamels... dyestuffs and woodstains... and in printing and dyeing textiles. As mutual solvents, glycol-ethers are used in soluble oils, insecticides, and dry-cleaning soaps.

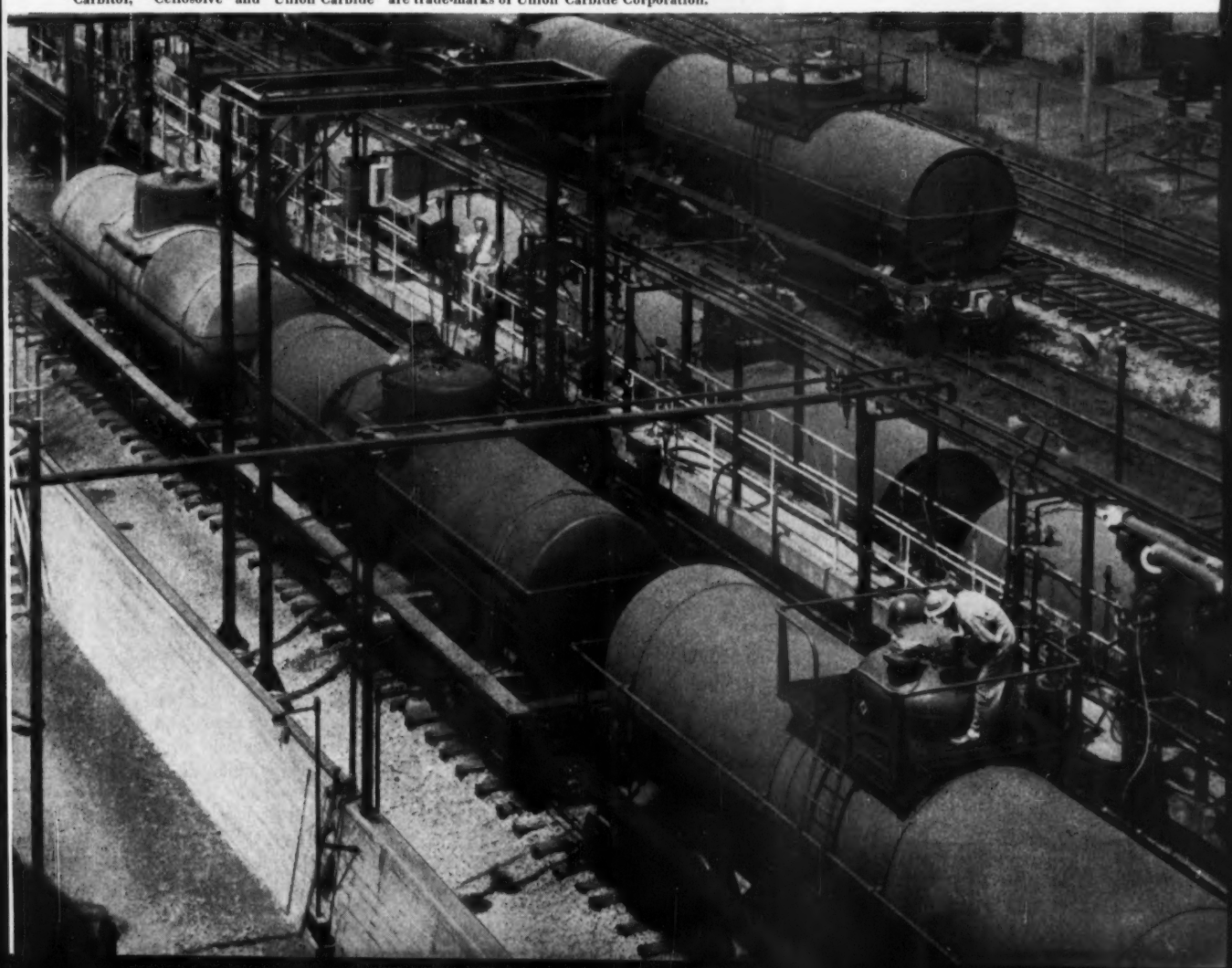
Because of the wide-ranging properties of the glycol-ethers, you can formulate for best results. You have a choice of CELLOSOLVE or CARBITOL solvents with a relative evaporation rate of less than 1 to near 50 (n-butyl acetate = 100). Boiling points range from 124.6° C. to 259.1° C. (at 760mm Hg.).

You can order CELLOSOLVE or CARBITOL solvents in compartment tank car shipments or combination car load and truck load shipments—resulting in considerable savings. And, you're assured quick deliveries from 52 warehouses—one of which is in your area... and from seven plants—and 14 bulk stations—located across the country.

To help you choose the best solvent system to strike the ideal balance between cost and performance in your formulations, send for the handy 6-page "Solvent Selector." It gives information on all glycol-ethers and 32 other solvents. Write... Dept. HC, Union Carbide Chemicals Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y.

UNION CARBIDE CHEMICALS

"Carbitol," "Cellosolve" and "Union Carbide" are trade-marks of Union Carbide Corporation.



NOW

Portland, Oregon Bulk Unloader Ready to Slash Import Costs

Portland Public Docks proudly announces completion of its giant new straight-line bulk unloader and pier—the only plant of its kind on the Pacific Coast! With a rated-capacity of 900 tons-an-hour, this facility cuts the heart out of dry bulk importing costs and puts the savings in your pocket.

- direct transfer from ship to rail or truck
- 140-car rail yard
- open storage area
- cargo shed
- will handle all types of vessels . . . all types of dry bulk cargoes

Specially designed to create savings for importers of ores, ore concentrates, chemicals, salts, feeds and all dry bulk cargoes.

FOR COMPLETE INFORMATION CONTACT:
SALES-TRAFFIC DEPARTMENT

PORTLAND PUBLIC DOCKS

Operated by the Commission of Public Docks
3070 N.W. Front Ave. Portland 10, Oregon
CA 8-8231 Cable (DOCOM) TWX PD309U
EASTERN REPRESENTATIVE: Buckley & Co., 170 Broadway, New York 38, N.Y.

billion cu. ft. of gas. This area will store the "raw" helium to be supplied by the proposed private facilities. The raw material will be tapped for processing into 99.9% helium when needed.

Some opposition to the proposed price increase is anticipated from industry. Its over-all effect, however, will not be serious. The price paid to the USBM for helium at the plant represents less than half of the ultimate cost to the customer at the point of use. Consequently, the cost of helium delivered to the point of use probably would not be increased by more than 25-50%. And 85-90% of the helium used is taken by the government or its agencies. They would pay the largest share of the cost.

Reserves: All known helium reserves in the Western world are located within a 250-mile radius of Amarillo, Tex. They are estimated at 154 billion cu. ft. Helium is a very minor constituent of natural gas and 4 billion cu. ft./year of helium is wasted when the natural gas is used as fuel. The conservation program initiated by the government is aimed at extracting this helium from the gas before it is consumed.

The conservation program will benefit the petroleum industry in many ways: it will enable the industry to sell separately an inert constituent of the natural gas; by removal of nonflammable helium the fuel value will be upgraded; it will in effect increase the capacity of existing pipelines—because only hydrocarbons that will burn will be transported. The low temperature extraction of helium and nitrogen gives an opportunity to remove greater quantities of propane, butane and possibly ethane (some are taken out already) without reducing the heating value of the gas below a suitable minimum.

While the demand/supply picture for helium looks rosy for the next five years, private industry will spend $175-200 million for extraction plants to save an estimated 52 billion cu. ft. Government spending of close to $1 billion will be required to purchase the produced helium in order to assure a continued supply and to encourage the development of new uses. But since the supplies of this vital element are plainly limited, there seems little choice in the course of action.

BRIEFS

On muriatic acid solutions
Top-quality phenol
Extra-pure phosphorus trichloride

FAST WAY TO DILUTE MURIATIC ACID

You can probably save yourself some time by sending for our muriatic acid data sheet.

A quick look at the dilution table it contains tells you how much of the acid you need to make up solutions of various strengths.

The same sheet gives you good advice on safe handling of muriatic acid and lists our specifications.

A glance at these specs shows you how extremely pure our product is. "Hooker White" grade, completely free of arsenic and free chlorine, contains no more than 0.0001% iron, a maximum of 0.003% sulfates and 0.0002% maximum organic matter.

The commercial grade, nearly as pure, contains 0.0005% iron at most, a trace of free chlorine, 0.003% sulfates, not over 0.001% organic matter, and no arsenic.

Check the coupon for data sheet.

HIGH-QUALITY PHENOL

Typically assaying over 99.5% by bromination, our phenol has more than purity to please you.

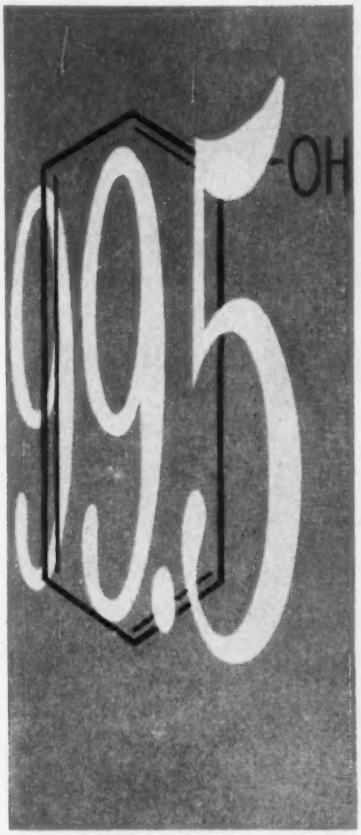
It has a freezing point of 40.6°C. minimum.

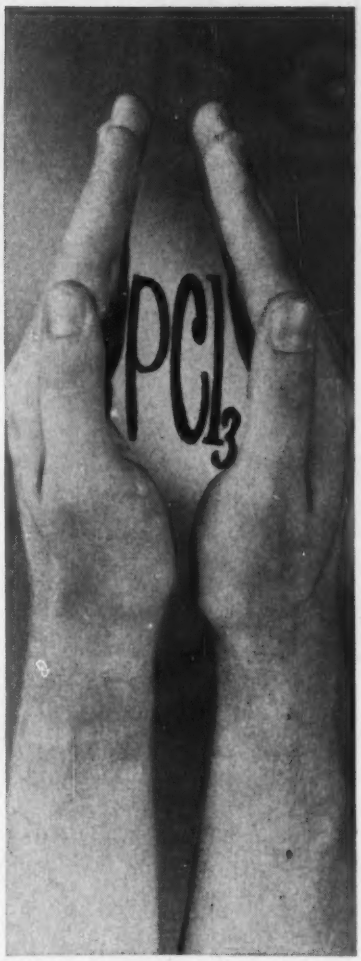
Its distillation range is only 2° from first drop (180°C.) to dryness.

Its color is 20 A.P.H.A. maximum at time of shipment.

Hooker phenol meets or exceeds the requirements of U.S. Pharmacopoeia XV.

Our data sheet gives all the specs. Just check the coupon.





EXTRA-PURE PCl_3 AT NO EXTRA COST

Why settle for less?

Our phosphorus trichloride is a water-white liquid that typically assays 99.9%. It has no free phosphorus, no turbidity.

It distills 97% between 74.5 to 78.0°C.

Use it as a chlorinating agent in making organic acid chlorides, as a condensing agent in preparing organic aldehydes, and as a catalyst in certain chlorination reactions.

For technical data sheet, just check and mail the coupon. For information on PCl_3 and other Hooker chlorinating agents, check the coupon for Bulletin 328-B.

For more information, check here and mail with name, title and company address.

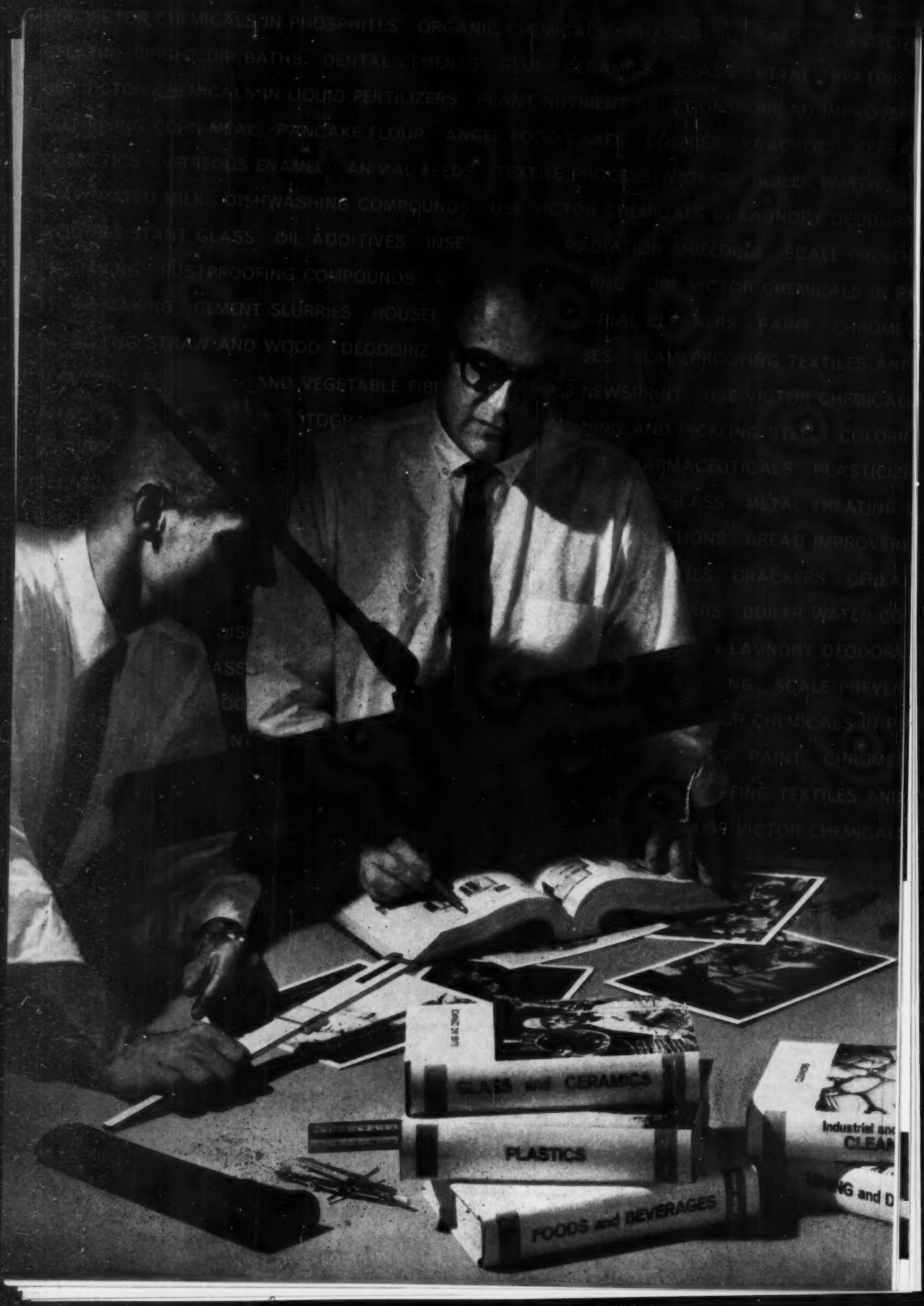
☐ Muriatic acid
☐ Phenol
☐ Phosphorus trichloride
☐ Bulletin 328-B

For the complete line of Hooker chemicals, see Chemical Materials Catalog or Chemical Week Buyers' Guide.

HOOKER CHEMICAL CORPORATION
709-1 Forty-seventh Street, Niagara Falls, N. Y.

Sales Offices: Buffalo Chicago Detroit Los Angeles New York Niagara Falls Philadelphia Tacoma Worcester, Mass.
In Canada: Hooker Chemicals Limited, North Vancouver, B. C.

HOOKER CHEMICALS PLASTICS


GLASS and CERAMICS
PLASTICS
FOODS and BEVERAGES

IT PAYS TO SEE VICTOR

DSP makes 'em scale-free

Once the boiler's securely in place, Victor phosphates go to work in earnest. DSP (trisodium, too) will keep feed water as scale-free as it's possible to be.

But that's only part of the story. Various Victor phosphates in combination with other chemicals help keep today's buildings cleaner and safer in many ways . . . through cleansing compounds, water softeners, acid type metal cleaners, soap builders, dishwashing and cleaning compounds, just to name a few.

In short, if any phosphate is . . . or should be . . . in your future, here's a prediction: "It pays to see Victor," as you'll see when you send for the new product folder. Check the coupon on the back.

Campus
Pancake
Shoppe

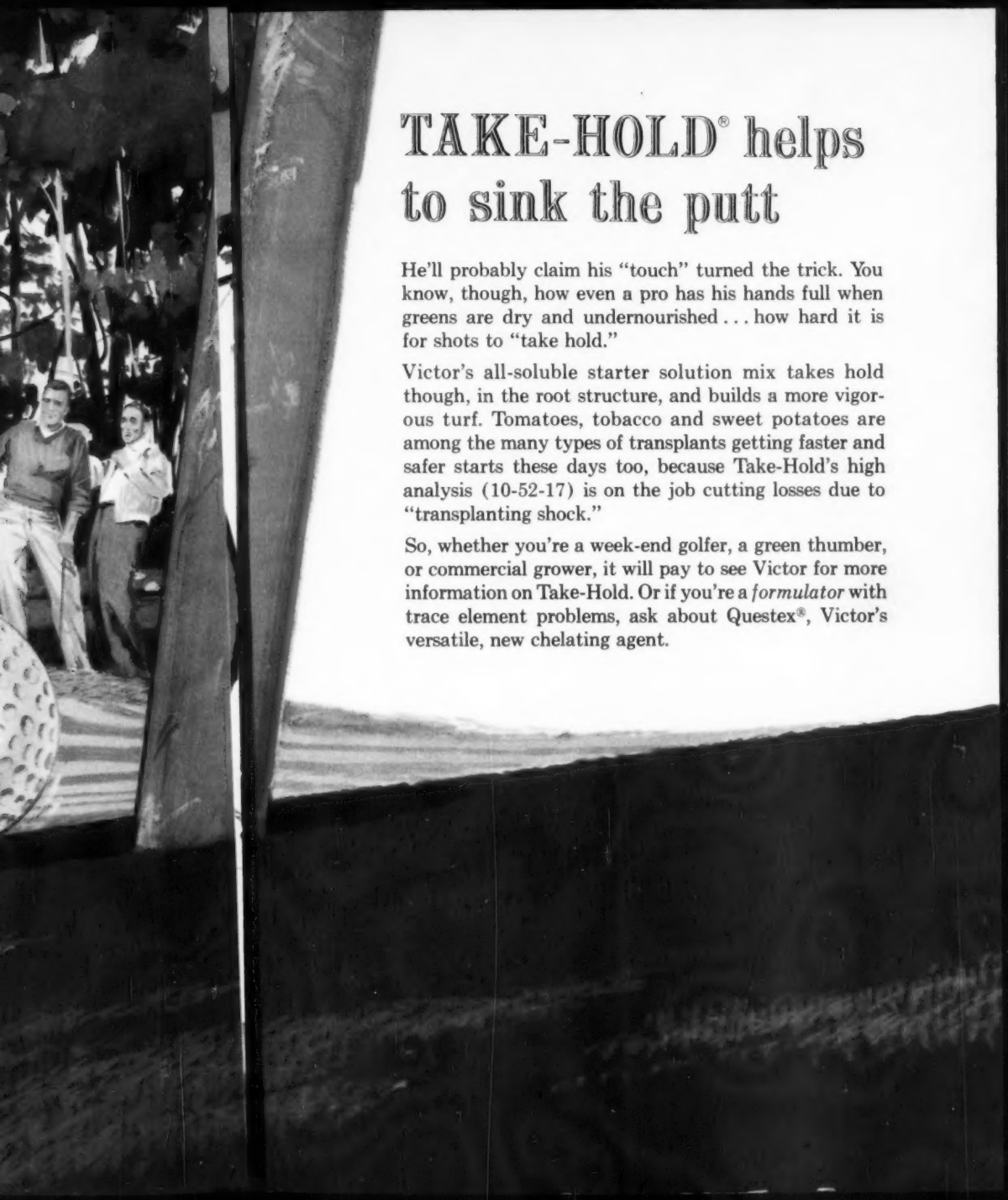
V-90® mixes profits with pleasure

Pancakes and waffles are pretty popular these days . . . especially after the big game. Customers say they *taste* better. Campus cooks claim it's quality plus *convenience.*

V-90, Victor's unique, coated, *anhydrous monocalcium phosphate* in the mix . . . makes a winning combination for that "homecoming crowd." 'Cakes will rise to perfection . . . stay tender and moist till the last bite.

Victor's leavening know-how stretches all the way from doughnuts to refrigerated biscuits. Yours may not be a *leavening* problem, but if you're in the food industry and looking for top-performance from a phosphate, we're sure you'll find as many others have . . . "It pays to see Victor."

VICTOR
Dependable Name in *Chemicals*
Division of Stauffer Chemical Company

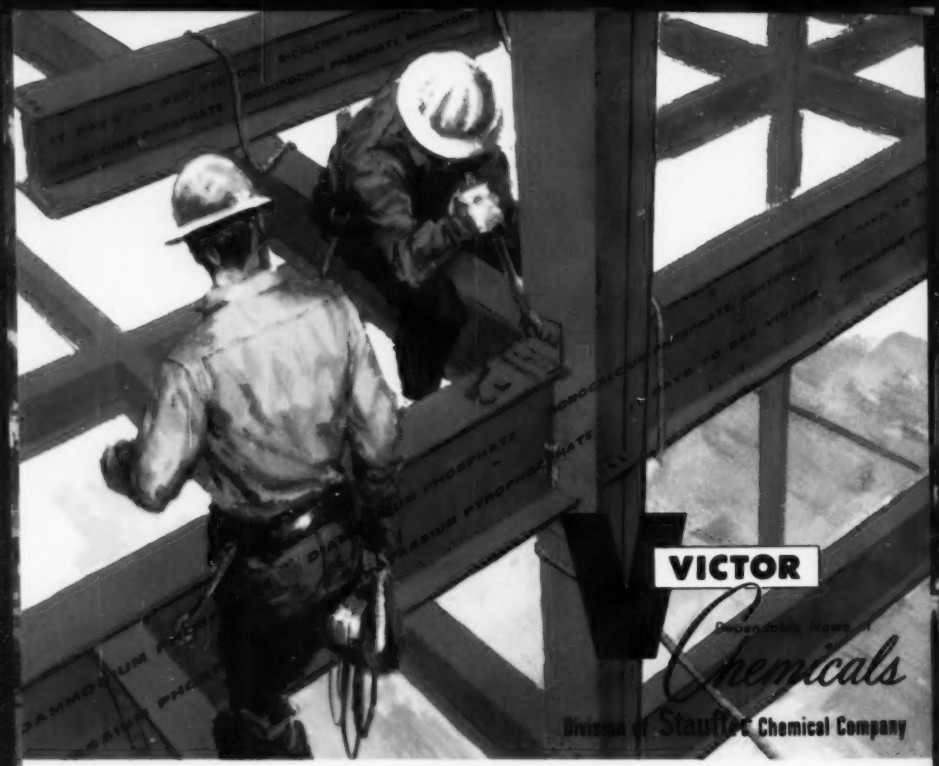


TAKE-HOLD® helps to sink the putt

He'll probably claim his "touch" turned the trick. You know, though, how even a pro has his hands full when greens are dry and undernourished . . . how hard it is for shots to "take hold."

Victor's all-soluble starter solution mix takes hold though, in the root structure, and builds a more vigorous turf. Tomatoes, tobacco and sweet potatoes are among the many types of transplants getting faster and safer starts these days too, because Take-Hold's high analysis (10-52-17) is on the job cutting losses due to "transplanting shock."

So, whether you're a week-end golfer, a green thumber, or commercial grower, it will pay to see Victor for more information on Take-Hold. Or if you're a *formulator* with trace element problems, ask about Questex®, Victor's versatile, new chelating agent.



VICTOR CHEMICAL WORKS, Dept. 47
Division of Stauffer Chemical Company
155 North Wacker Drive, Chicago 6, Illinois

Please send:

- ☐ Victor Product Folder
- ☐ Technical Service Bulletin V1-61
  "The Properties and Reactions of Phosphorus Pentoxide and Phosphorus Pentasulfide"
- ☐ Sales Release
  "Take-Hold® at home, at the nursery and in the greenhouse"
  (Revised Edition)
- ☐ Would appreciate additional information on:

....

....

Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....

Wherever phosphates are used

. . . whether an application or production problem is involved, chances are, one of Victor's line of ammonium, calcium, sodium or potassium phosphates can help. It's no secret that many industries use the *quality* and *dependability* of Victor products as guideposts. They have found, by design . . . or otherwise, that *Victor* phosphates can help push products *profitably* into today's ever expanding markets.

If you're investigating organo-phosphorus compounds, for example, a talk with Victor's special products and research laboratory personnel may be helpful. They'll welcome the opportunity to discuss your individual requirements in either pilot plant or commercial quantities . . . so if you're debating about new *products* or new *uses* for present products, remember . . .

IT *Pays*
TO SEE VICTOR
FOR PHOSPHATES

VICTOR *Chemicals*

VICTOR CHEMICAL WORKS, DIVISION
STAUFFER CHEMICAL COMPANY
155 N. Wacker Drive, Chicago 6, Ill.

Who Will

To keep pace with overseas expansion, U. S. chemical firms are confronted with the problem of building up their sales offices in foreign nations. But fewer Americans are slated for chemical process industries marketing work abroad; and large-scale hirings by the booming foreign chemical industries have cut sharply into the available supply of foreign nationals. To fill in their overseas sales forces U. S. firms are utilizing a number of techniques to hire—and hold—competent staffers.

At present, the shift of domestic salesmen to overseas posts has taken a permanent back seat to on-the-spot employment of nationals. Most firms, —Union Carbide, for example—have few Americans in sales positions abroad, would prefer to have none eventually.

There are several reasons for this attitude. (1) Many countries require the hiring of nationals. (2) Generally, the foreign pay scale is considerably lower than that in the U. S. (3) Companies avoid the problem of selecting and training domestic men to fill overseas posts. Clear case in point: of Dow Chemical International's total overseas force of 1,500, only 55—less than 4%—are American.

Need for Nationals: Management men emphasize the need for salesmen who can deal easily with any of the multitude of European nationalities. Probably the most important requirement is fluency in English, often designated as the official company language. However, Parke, Davis, looking for overseas medical representatives, found that hiring only English-speaking nationals often narrowed its choices, now thinks it easier to give language instruction after employment. One West Coast firm prefers, if possible, to hire nationals from an affiliated overseas operation. It only goes to outsiders when there are no candidates available from company sources. But like nearly all other CPI concerns, this one offers nationals the chance to work up the ladder to middle and often top management positions. In some cases, to reach these levels, nationals are brought back to the U.S. for detailed

Fill the CPI's Overseas Sales Jobs?

sales orientation training. However, this step is usually limited to smaller overseas operations and, even then, to only a key national, one who is tabbed for the top sales job in his region.

Soothing Feelings: But many problems are presented by hiring nationals. Since lower standards of living mean that pay scales run about one-third to one-half what an American receives overseas, many firms find that they have to be on guard against hurting sensitive feelings. To circumvent the problem one firm points to the company policy of paying nationals on the U.S. scale if they are trained here and are then sent abroad. Another solution, followed by Sherwin-Williams, is simply to up the national's compensation until he receives the same as his U.S. counterpart.

More important than this, though, is the growing difficulty in locating qualified foreign personnel. It is a real problem in highly industrialized countries where U.S. firms compete not only among themselves but also with a strong national chemical industry. Japan provides a good illustration —one American company now finds that it has to recruit, as it does in the U. S., from colleges, often promising jobs one year before graduation. And pay, although within the current industrial rate, fluctuates noticeably, with firms constantly offering just enough more to gain a better hiring position.

Local inflation can also put a company's plans out of kilter. Examples: Argentina and Brazil, where a CPI concern has had to give two across-the-board increases of 15% each in the last eight months and, an executive emphasizes, the end isn't in sight yet.

Elsewhere, as in Germany, chemical firms, especially those selling drugs, also run up against the low status of sales work. Management of one company notes that doctors, biologists and pharmacists who, in the past, were hired as pharmaceutical detail men now tend to look down on this form of employment. Their reason: too many better openings elsewhere in a fast-moving German economy.

But the advantages of having a national in a foreign sales post far overshadow the drawbacks. And on-the-job performance has forcefully proved the wisdom of this policy. As one American executive put it: "Our experience has given us . . . complete confidence in our foreign sales personnel. If we didn't have it, we wouldn't entrust them with the responsibilities of selling our product."

Yet on the other hand, the presence abroad of experienced domestic marketing people—as sales managers—is pretty much a necessity for the CPI firm that's starting a new overseas sales office—at least until it is well established.

How They're Selected: Almost all companies agree on the qualities needed for foreign work. Dow checked off these key characteristics: individual flexibility, family mobility, outstanding sales success in previous assignments. Knowledge of a foreign language isn't always a necessity in preliminary selections.

Selection procedures vary, of course, but a leading West Coast paint and glass manufacturer follows a format that could probably apply to many other companies. Overseas candidates go through interviews with two or more members of international and personnel management who look for backgrounds that include command of a foreign language and knowledge and appreciation of foreign customs and cultures. If the right sales people can't be found with the parent company or an overseas affiliate, the firm will go outside to employ and train a man. Goodyear International's Chemical Division follows a similar path when, after culling the sales staff, it goes after graduate chemical engineering students. Those with foreign commerce education have an advantage, but this combination is rare, and Goodyear admits that high company standards are one cause of a "chronic shortage of . . . good men."

There are, however, other sources for overseas sales people. One large CPI firm turns regularly to the American Institute for Foreign Trade (Phoenix, Ariz.) to fill some of its needs. The company's recruiters look for men with majors in foreign sales, minors in chemistry or biology. Since '57, four men have been hired from the Institute for the company's overseas sales training program.

Rorschach, Too: And because of the cost involved—anywhere from $5,000 to $25,000 to place a man and his family overseas—many firms try to cut the chances of a poor employment risk by turning their choices over to management consulting firms for further screening. One such firm, Richardson, Bellows and Henry (New York) will take two full days to assess the man and his wife, giving both a series of projective tests, including the Rorschach, and joint and single interviews. RBH psychologists try to determine how the couple lived in the U. S., whether or not they adjusted to any sharp changes in domestic environment (such as moving from the deep South to New England) and what their family ties are in this country (an overly strong attachment could be harmful overseas). Over-all they find little fault with their clients' candidates, but state that the basic trouble with some is that they simply have not been well briefed by the company, are thus not aware of the problems involved in working overseas.

Training: Once selection and screening are completed, most CPI firms find they must spend anywhere from several weeks to two and a half years in training sales personnel for foreign assignment. Goodyear puts its recruits through a one-year program designed to teach them how to sell in the countries in which they will work. This includes teaching fluency in the native language, as well as instruction in the local political situation and how it affects selling.

Going a step further, Dow International maintains that it gets its best results by moving both the potential salesman and his wife to the Michigan State University campus for two weeks, in an attempt to provide a distraction-free training program. During this schooling period, the couple spends 120 hours in several areas of instruction, including lan-

guage tutoring and study of the country's economic, social and political system.

What all this emphasis on training may show is a shift in the responsibilities of marketing men headed overseas. According to Goodyear, chemical sales positions in the U.S. require 90% chemical qualifications and about 10% commercial knowledge—e.g., the ability to handle pricing, terms, contract conditions. But in the international field, the general sales manager must be able to handle nearly all the actual day-to-day routine of business. Goodyear believes the overseas sales representative should have at least as much commercial know-how as technical.

Way to Pay: And a company must be ready to pay for this preparation. Overseas salary is usually composed of the base pay the man would receive for the same job in the U. S. plus a bonus, which can jack up the total as much as 20%. For example, Sherwin-Williams gives the junior salesman stationed abroad about $12,000 compared with $8,000-$10,000 for the identical work in the U. S. Added to this often are fringe allowances computed from Dept. of Commerce cost of living indexes. Some firms, however, restrict these extras to sales people in primitive, underdeveloped regions. For those selling out of urban areas—like Paris and Rio de Janeiro—only the base and bonus apply.

Just how to pay can present a problem to the chemical firm that plans someday to move its "expatriate" sales personnel back to this country. Management can run into some serious difficulties when a marketing man realizes that his salary must be readjusted to U. S. levels after his return. To avoid the impression of a salary cut—and the possibility of a resignation—some firms now put salary and extras on separate checks. This can help to soothe homebound personnel. As one executive points out, the salesman must realize that he was getting "extra pay for extra problems."

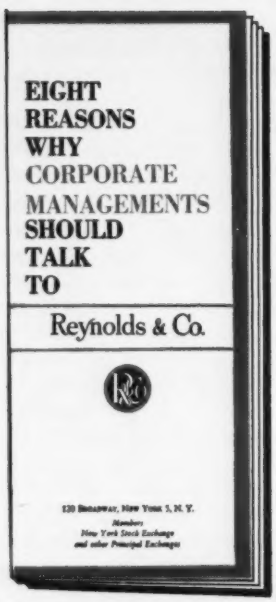
For its part, the industry will continue to spend considerable money and time in the talent hunt for the right overseas sales personnel, U. S.-born and nationals alike. And the end result—a top-flight sales staff—will justify the effort.

WHEN *you or your company need . . .*

- **New money for expansion or working capital**
- **To effect initial public sale of stock in a privately-held company**
- **National distribution of secondary stock offerings**
- **To arrange an acquisition, merger, or sale**
- **A pension or profit-sharing plan**
- **To carry "future" inventory through commodity transactions . . .**

. . . it might be worth your while to turn to Reynolds & Co., one of America's leading investment banking and brokerage houses. And these are just some of the services we offer corporate management.

The various areas in which we can help executives are summarized in a new brochure entitled "Eight Reasons Why Corporate Managements Should Talk To Reynolds & Co." For your copy, just clip this coupon to your corporate letterhead.



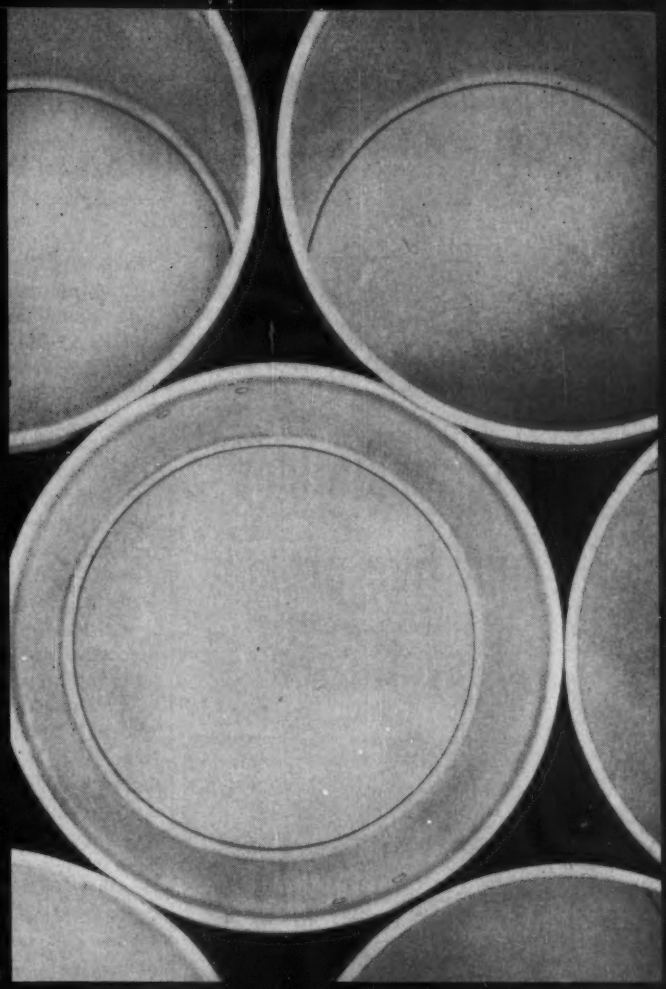
Reynolds & Co.

Members New York Stock Exchange
and other Principal Exchanges
Underwriters and Distributors of
Corporate and Municipal Securities.
Brokers in Securities and Commodities
MAIN OFFICE:
120 Broadway, New York 5
37 Offices From Coast to Coast

Reynolds & Co., 120 Broadway, New York 5
ATTENTION: MR. ROBERT E. PALMER
Please send me a copy of your brochure "Eight Reasons Why Corporate Managements Should Talk To Reynolds & Co." Address it to:

(YOUR NAME. PLEASE PRINT.)

ALL LINED PAILS LOOK THE SAME FROM THIS ANGLE



RHEEM PAILS LOOK THE SAME FROM THIS ANGLE, TOO

Rheem Centrifugal Lining process makes pail linings completely uniform...completely dependable

No pinholes, no blisters, no skips, globs nor thin spots occur in lining applied by this patented method. Thickness is controlled to 1/10 mil tolerance over every inch of pail interior.

The Rheem Centrifugal Pail Lining process was developed especially for coating the interiors of cylinders. By using the highly efficient principle of centrifugal force instead of conventional spray gun techniques, it assures a new excellence in protection for products packed in pails.

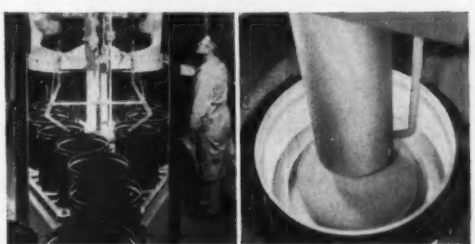
Every pail lining variable is controlled: amount of lining applied, application angle, application speed. All are invariably uniform ... and so are the finished linings. The automatic Rheem process eliminates air turbulence, human error and reduces solvent content, too.

It's a process that assures the same product purity on delivery as at filling.

If you are now using pails lined by another process, or using packages of other basic materials, write for samples, information on linings or a testing program to 1701 West Edgar Road, Linden, N. J. Plants across the country.

WORLD'S LARGEST MANUFACTURER OF STEEL SHIPPING CONTAINERS

Rheem



How it works: Pail shells move up to automatic Centrifugal Lining equipment (left). Positioning arms clamp pail and (right) raise it past spinning centrifugal applicator head. Angle, distance and speed never vary. Result: completely uniform linings – completely dependable protection for your product.

Dawe's

Specialists in industrial fermentations and fine organic syntheses

BASIC PRODUCERS OF:

GLUCONIC ACID
SODIUM GLUCONATE
CALCIUM GLUCONATE
GLUCONO-DELTA-LACTONE
GLUCOSE OXIDASE
FRUCTOSE (LEVULOSE)
VITAMIN D
CHOLINE PANTOTHENATE

Request technical data, samples and prices. You can depend on Dawe's high quality and prompt, personalized service.

Dawe's

DAWE'S LABORATORIES, INC.
4800 South Richmond St., Chicago 32, Ill.
Plants: Chicago, Ill., Peoria, Ill., Newaygo, Mich.
Foreign Offices: Italy—Viale Abruzzi 94, Milan
Mexico—Apartado Postal 30209, Mexico 7, D.F.

SALES

DATA DIGEST

• **Aliphatics:** Catalogue lists some 150 different products in the company's aliphatic organic chemical line, along with specifications and typical applications. Book contains additional section on fatty acid analysis by gas chromatography. Armour Industrial Chemical Co. (110 N. Wacker Drive, Chicago 6).

• **Silicone Rubber:** Technical bulletin describes the properties and handling characteristics of silicone rubber, gives comparative data on radiation resistance and dielectric strength. Silicone Products Dept., General Electric (Waterford, N.Y.).

• **Methyl Ethyl Ketone:** Safety data sheet details the properties, hazards, waste disposal requirements and medical management of methyl ethyl ketone. Manufacturing Chemists' Assn. (1825 Conn. Ave., N.W., Washington 9, D.C.).

• **Pearl Pigments:** Brochure illustrates applications of pearl pigments incorporated into vinyl film and sheeting, thermoplastics, and cast plastics. Other uses include coating and printing on wide range of plastics. Mearl Corp. (41 E. 42 St., New York 17).

• **Adhesives:** Booklet reviews the technology of skin and blister packaging and the special adhesives used for these operations. Among the plastics discussed: cellulose acetate, polyethylene, cellulose acetate butyrate and oriented polystyrene. Other subjects include adhesive applications, ink and surface contaminants, testing services. Borden Chemical Co. (350 Madison Ave., New York 17).

• **Lubricant:** Data sheet presents characteristics, performance reports and application instructions for Molykote X-15, an inorganic-bonded dry film lubricant for use in extreme environmental conditions (—300 F to 1200 F). Alpha-Molykote Corp. (65 Harvard Ave., Stamford, Conn.).

• **Metal Finishing:** New, 6-page brochure describes diversified line of metal finishing processes, plating chemicals and equipment. Enthone, Inc. (442 Elm St., New Haven 8, Conn.).

• **Specialties:** Chemical Formulary (Vol. XI) gives directions for chemical specialties ranging from adhesives to garden chemicals. Also included: a tradename directory. Chemical Publishing Co. (212 Fifth Ave., New York 10).

VERSATILE, POWERFUL
DISPERSING AGENTS
LOMAR®
series of naphthalene sulfonic acid condensates

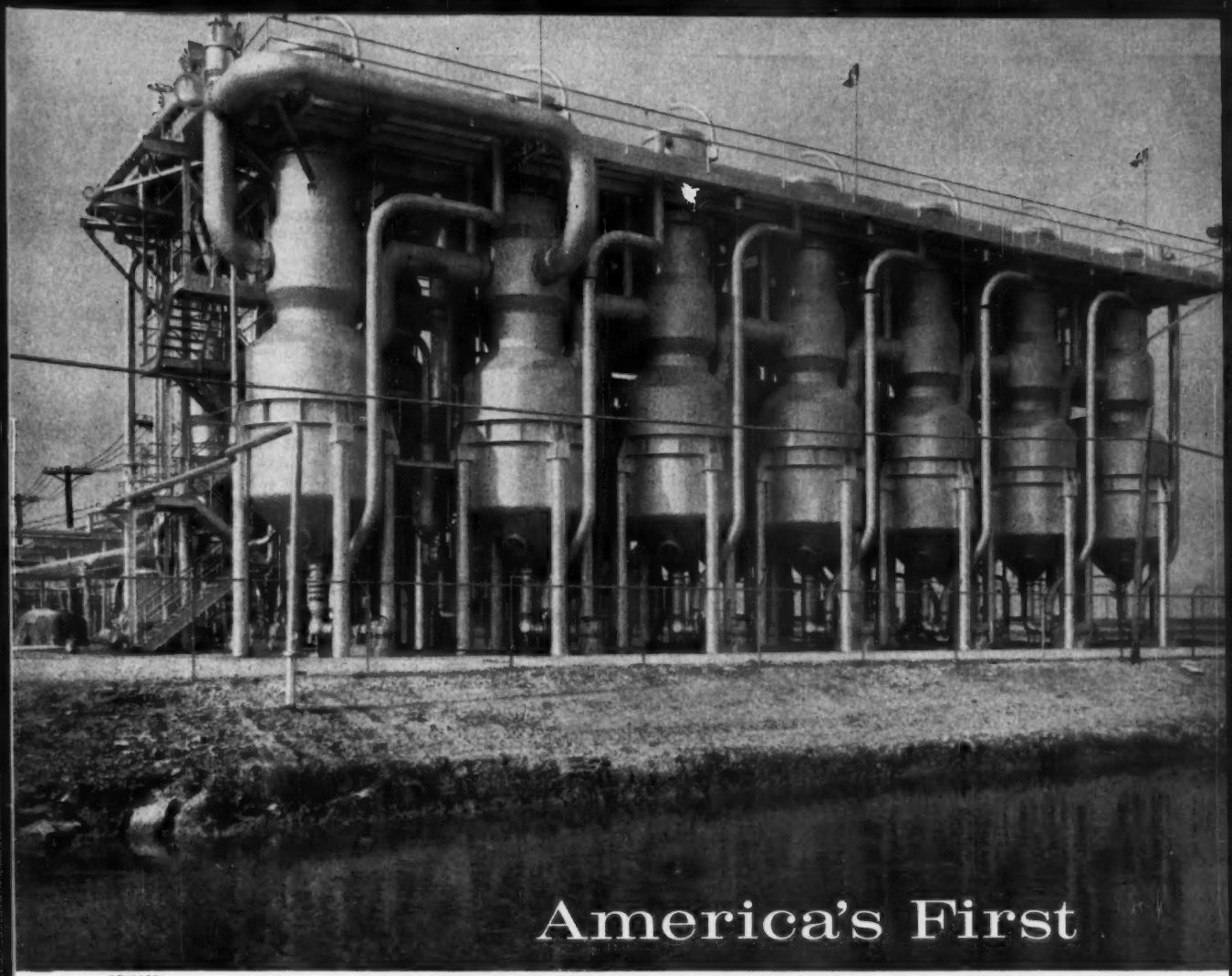
The Lomar series supply the powerful dispersing properties required to handle dyes, pigments, clays, graphite, mica, carbon black, and other inert powders. They improve manufacturing processes as well as finished products in fields involving:

Cement
Plaster
Ceramics
Wet milling
Paint and asphalt emulsions
Pitch and slime control in papermaking
Preventing coagulation in latex
Foundries
Tanning

New! We have just published a booklet on the Lomar series. It contains full information on this valuable line of dispersing agents. Send for a free copy today.

JACQUES WOLF & CO. Chemicals Newark, N.J.

A SUBSIDIARY OF NOPCO CHEMICAL COMPANY
Plants: Harrison, N.J. • Carlstadt, N.J. • Richmond, Calif. • Cedartown, Ga. • London, Canada • Mexico, D.F. • Corbeil, France • Sydney, Australia



CB-6122

America's First Experimental Seawater Conversion Plant

The steady decline of available fresh water may well find economical solution through this new experimental saline water conversion plant. It's America's first installation.

Built by CB&I for the Office of Saline Water, U. S. Dept. of Interior, it is capable of producing 1,000,000 gallons of fresh water daily from the salty Gulf of Mexico at Freeport, Texas. The facility is expected to produce this volume for less than $1 per thousand gallons.

Valuable operating information, including methods of combating corrosion and scale formation, will be provided for future and larger installations to follow.

CB&I completed the design, fabrication and erection of the steel structure in less than a year. This included an 8-day test run.

To learn how CB&I's extensive experience with process design, fabrication and erection in many fields can be advantageously applied to your plant problems, write to Chicago Bridge & Iron Company, 332 South Michigan Avenue, Chicago 4, Illinois. Offices and subsidiaries are located throughout the world.

CB&I **built it!**

DOW BADISCHE

NOW ON STREAM

A NEW SOURCE IN 1961 FOR n-BUTANOL AND iso-BUTANOL

A new Dow Badische plant for manufacturing n-Butanol and iso-Butanol is scheduled to go on stream in 1961. These products will be marketed by The Dow Chemical Company and are available singly or in mixed shipments with other Dow products such as—

Dowanol® glycol ethers • *Ethylene glycols* • *Propylene glycols* • *Glycerine* • *Chlorinated solvents* • *Dowfax® 9N9 surfactant.*

Dow Badische is a new company owned jointly by The Dow Chemical Company and BASF, Overzee, N.V. Dow Badische unites a combination of American and European production and research know-how with American marketing skills. These alcohols are a new addition to this company's expanding product line.

For more information, write to THE DOW CHEMICAL COMPANY, Midland, Michigan.

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

Coated Papers Roll Up Gains for Latex

Use of synthetic latexes as adhesives in pigmented paper and paperboard coatings has developed into a $15-million/year market.

A new polyvinyl acetate latex is now being readied in the laboratories of Morningstar-Paisley, Inc. (New York). It's being tailored for papermakers—to help them provide a type of paper better suited for fancy, four-color printing—and it'll be competing with a variety of synthetic latex products for a market worth $12-15 million/year.*

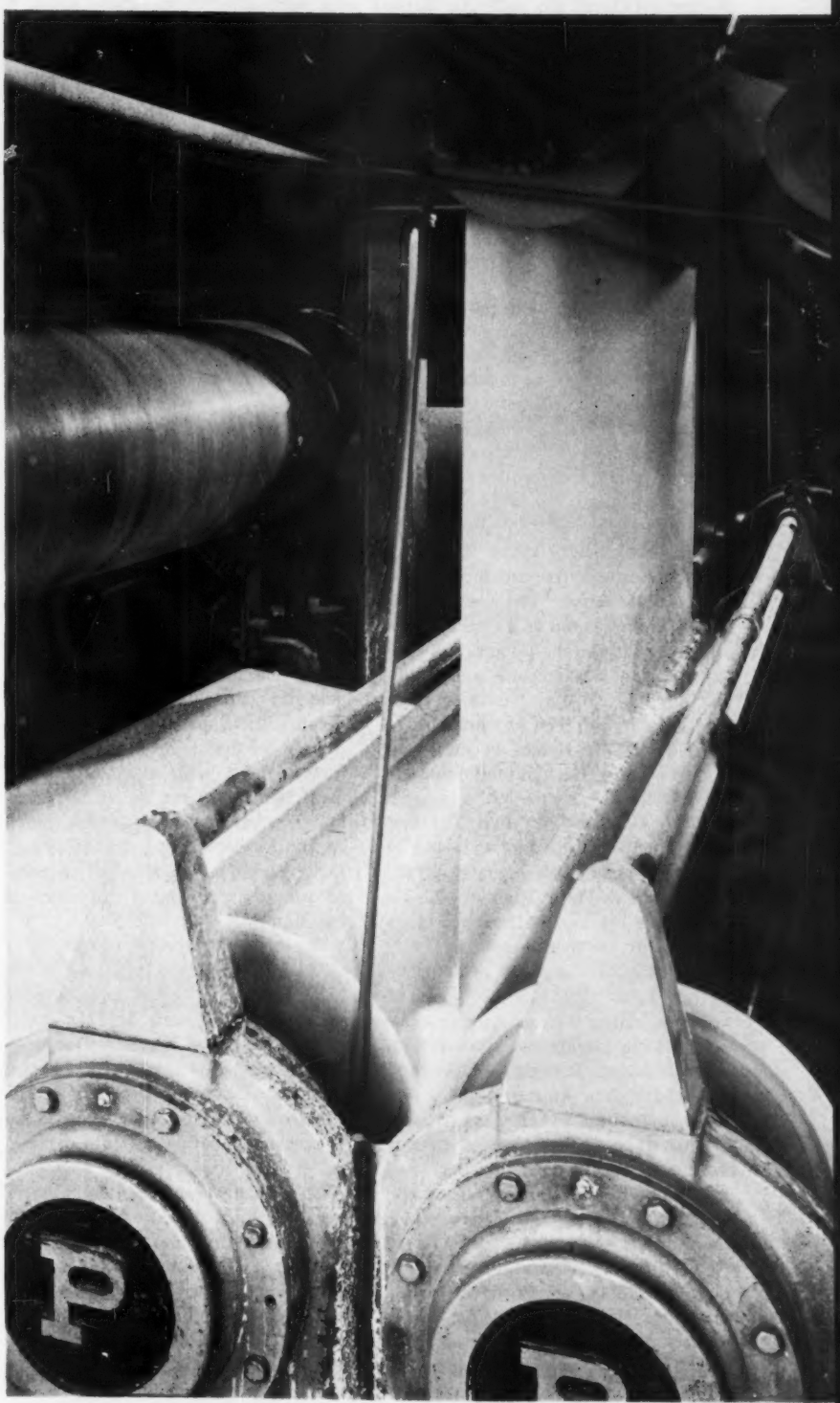
These synthetic latex products have boomed in popularity in the last dozen years or so because they are superior to naturally derived pigment binders (starch, casein) in low viscosity combining with heavy coating weights. This combination of properties is vital to the operation of the new, high-speed paper-coating machines. And the synthetics have provided a bonus of higher gloss, better ink holdout, more flexibility and better water resistance.

The present synthetic latex pigment-binding market is divided among three types: Styrene-butadiene types, which are by far most widely used; some 25-30 million lbs. (dry weight) of resin go into this use yearly. Next are acrylics (and to a limited extent acrylic-polyvinyl acetate copolymers), for which there is a growing market of 8-10 million lbs. And in third place, but growing faster than the others, are polyvinyl acetate latexes, which have sales now in the 4-7-million-lbs. range.

Just as the field is split among these three materials, it's also divided among three major suppliers: Dow, which dominates the butadiene-styrene business; Rohm & Haas, the acrylics leader; National Starch, the acetate frontrunner.

Pioneering: A pioneer among commercially successful synthetic paper coating adhesive was Dow's Latex 512-K, introduced in '48. This prod-

* 1961 estimate, which reflects the growth of the market in recent months (*CW, July 15, p. 79*).



Latex binder being applied on horizontal size press at Rex Paper Co.

uct and its successors, Latex 512-L, Latex 630, etc. have kept Dow the dominant figure in the field. Most industry sources give Dow at least 90% of the styrene-butadiene market, rate Koppers (which got into the paper field with its Dylex latex about five years ago) as No. 2 source of this type product. Other suppliers, including Dewey and Almy Division, W. R. Grace & Co., Naugatuck Division, U. S. Rubber Co., General Tire and Rubber Co., Goodyear, Firestone and Borden share 3-4% of the business.

Styrene-butadiene's major selling point is its low price. Its cost range is 27-32¢/lb.—well below the 32¢/-lb. minimum being asked for acetates and the 45¢/lb. price for acrylics. Butadiene-styrenes are competitive in use cost with the low-priced, enzyme-converted starches (6½¢-7½¢/lb.) and caseins (18-30¢/lb.) because they are used in much smaller amounts than these materials.

The publication-grade papers (magazines, books, etc.) appear to be almost exclusively the province of the styrene-butadienes. The practice is to use the resins not as a total replacement for the starch, caseins, and protein pigment binders but as an additive to improve their viscosity, gloss and calendering. The amount used—25-65% of the starch weight — is enough to mean a multimillion-pound market for the synthetics.

Clear Case for Acrylics: The first acrylic emulsion to find wide use in the paper field as a pigment binder was Rohm & Haas' Rhoplex AC-33, a product originally developed as a vehicle for water-base paints.

The acrylics came into prominence in this field, as a binder for board coatings, rather than as a paper coating (the big market for styrene-butadiene). Styrene-butadiene had been around for some time as a board pigment binder but had certain drawbacks (many since corrected) that limited its use in this field. Better light and heat stability and less odor gave the acrylics an advantage here despite their higher price.

One industry source (not Rohm & Haas) credits the success of the acrylic latex pigment binders to a paper maker—West Virginia Pulp and Paper. That company in the mid '50s began to offer a trailing-blade-applied (descriptive of the machine which puts on the coating) coated board for the same price as uncoated material. Other companies were asking $20-$80 upcharge for coating. The material that West Virginia employed for the pigment binding was Rohm & Haas' acrylic type Rhoplex B-15. This sold for 55¢/lb.—but others besides WVP&P used it, because of the superior properties it imparted.

The acrylic price has come down during the past several years; also, many of the papermakers, following the lead of Riegel Paper, have switched from a one-coat to a two-coat system.

This has not doubled the usage of binder, but it has increased it considerably. And the acrylic cost is still relatively high; some papermakers are giving serious consideration to the use of the cheaper latexes. Now some are using butadiene-styrene for the first coating (where odor and yellowing are minimized) and are covering it with a polyvinyl acetate or an acrylic final coat.

Rohm & Haas probably has 95% of the acrylic pigment binding field, but it's not the only factor in the field and competition is increasing. Earlier this year Union Carbide entered this market with a small-particle-size latex (0.2 microns) which it calls Ucar Paper Coating Binder 40. Also in the field is A. E. Staley Manufacturing Co. with its Stacrylic pigment binder, offered since '59. General Tire has offered an acrylic, called Acriflo for paper pigment binding and Dow is reported to have had an acrylic out in development quantities at one time.

Slow Start: Polyvinyl acetate, after a rather inauspicious beginning in the paper field, has begun to take over some of the markets held by butadiene-styrene and acrylics. One area in which the vinyl acetate binders seem to have made major inroads is in the breadwrap field (the pigment used here is almost exclusively titanium dioxide, rather than clay).

The butadiene-styrene latex binders were used in this field when roll coating was predominant. Shortly after the switch to trailing-blade coating, the acrylics first made some headway against the s-b resins but they in turn have given way to the acetates. At present, National Starch's 1103 vinyl acetate latex is probably the top breadwrap PVAc produced in the U.S.

Besides National Starch, which supplies well over 90% of this market, Shawinigan, Dewey & Almy and Borden Chemical are in the PVAc field.

Offset Growth: The synthetics appear to have a bright future in the growing field of offset printing. The use of tackier inks (calling for better adhesion) and demand for increased water resistance are trends that give the synthetic polymers an advantage over proteins and starches. This is especially so now that the industry has switched to the higher speed web-fed offset printing presses in place of sheet fed units. While doing this the printing industry has also tried to get the same properties from lightweight papers that it got from heavier weights.

Combinations of the natural and synthetics are now also used for offset papers. Polyvinyl acetates which are relatively water sensitive, seem to have less potential here than butadiene-styrene or acrylic-type latexes.

Not the Final Answer: Though the synthetic latex pigment binder market seems a bright and growing one, the progress isn't all on the side of the synthetic latexes. There has been a lot of work done to enhance the properties of starch and casein. Borden is currently offering a casein (Protovac), said to provide high solids (62-65%) at much lower viscosities than caseins have had in the past.

Nevertheless, synthetics have the solid respect of papermakers. John C. Stinchfield, research section leader of S. D. Warren Co. (Westbrook, Me.), acknowledges the cost advantage of natural latexes, believes the synthetics are well worth the additional cost because they give a superior product. He added that his company has not switched over to pure latex binders because unless a casein and starch are used also, the resulting paper is limp.

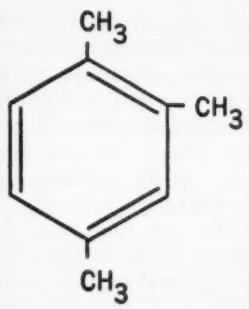
Frederick H. Frost, vice-president of the same company, points out that stability of the latex prices are useful in estimating production costs.

One of the drawbacks of the latex systems seems to be their lack of stability in high-speed coaters (the latexes coagulate). Work to correct this is encouraging, however. And the research by synthetics latex producers

What's News in Enjay Chemicals...

PSEUDOCUMENE

TYPICAL INSPECTIONS



Pseudocumene (wt per cent)	95.0
Distillation °F	
Initial	335
50 per cent	337
Dry Point	340
Color	Water White
Doctor Test	Pass
Flash (Tag Closed Cup) °F	119
Specific Gravity (60/60°F)	0.878

FIRST from Enjay in commercial quantities . . . pseudocumene (1,2,4, trimethylbenzene) is now available for immediate delivery. Enjay pseudocumene is a low-cost, highly reactive, aromatic hydrocarbon which can be readily converted to intermediates for production of surface coatings, plasticizers, drugs, dyes and many other products.

Pseudocumene will be used commercially in large quantities to produce trimellitic anhydride for use in the manufacture of surface coatings and plasticizers. A blend of pseudocumene and bromobenzene has been found to possess a very high viscosity index, making it a possible useful hydraulic medium in control apparatus designed to operate over wide temperature ranges.

COMPLETE INFORMATION – For a new Pseudocumene Brochure #D-16, write to Enjay, Room 1131, 15 West 51st Street, New York 19, New York.

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

ENJAY CHEMICAL COMPANY

A DIVISION OF HUMBLE OIL & REFINING COMPANY

ENJAY

COPPER SULFATE

We Have The Crystal Size To Fit Your Particular Needs

LARGE • MEDIUM • INDUSTRIAL • GRANULAR • SNOW and POWDERED

WE ARE BASIC PRODUCERS OF COPPER

Our basic position and technical experience in COPPER CHEMICALS is your assurance of highest quality and uniform consistency.

Phone JAckson 3-5024

TC TENNESSEE CORPORATION
612-629 Grant Building, Atlanta 3, Georgia

has also spurred efforts by the natural product makers.

Frost predicts great advances in the field—but says "latex isn't necessarily the ultimate."

A spokesman for Champion Paper Co. (Hamilton, O.) favors latexes because they allow a heavier coat to be applied in a shorter time than the older binders. A typical natural coating was 50% solids and 50% water; synthetic latexes form 65-70% solids, so much less heat must be applied to dry the coating.

George Sheets of Mead Paper Corp. (Dayton, O.) says that the growth of offset printing has led to the increased use of the latex system. It could mean that the polymers will become even more important.

But the field of paper coating is changing too rapidly to predict that with assurance. For the next few years, however, look for the latex pigment market to climb well over the 50-million-lb./year mark. It's not a bad record for a material that wasn't even in existence before '48.

Feat on the Ground

A portable spray gun unit with which nondrifting invert herbicides can be applied from the ground has been developed by Stull Chemical Co. (3400 Nacogdoches Rd., San Antonio, Tex.). In the past only aerial applications of the mayonnaise-like herbicides were practical.

The new unit has a 50-ft. spray radius, weighs less than 100 lbs. and can be operated from a pickup truck. Using a 7½-hp., air-cooled gas unit, the system is hooked to a drum of water by one feed line, to the chemical formulation by another. The two components (along with a surfactant, emulsifier and sticking agent) are forced through a special mixing nozzle before spraying.

Stull has also developed its own herbicide spray mixtures. Other companies, such as Amchem Products (Ambler, Pa.), have also done considerable work in developing such formulations for herbicidal and insecticidal use.

Acrylic Thickener

Rohm & Haas (Philadelphia) is offering pilot-plant quantities of a new acid-containing acrylic emulsion co-

SILICOLOGY *Studies in Silicones*

HOW THESE TIME-TESTED MATERIALS CAN WORK FOR YOU

Silicones a Brilliant Success in Specialties —Polishes Are a Shining Example!

In the past fifteen years hundreds of chemical products have gotten a lift from silicones. And now they are playing a large part in the aerosol revolution. If you are interested in aerosols (and in making sales), you might get some notions here. We'll take polishes as an example.

POLISHED PERFORMANCE

Basically, silicone fluids upgrade car polishes for these reasons: They're incompatible with most organics, including wax crystals to which they impart lubrication. This makes buffing to a high luster easier. Being insoluble in fat and oils, they enable cleaner-polishers to reduce adhesion of surface grime. Their well-known water repellence helps protect surfaces against water-borne stains. Oxidation resistance makes them very long lasting. And since they undergo minimum viscosity change with temperature variation, they are easy to apply at all temperatures.

There are, of course, problems to be met. One is the effect of emulsifiers on gloss and appearance. For aerosol furniture polishes a substantive emulsifier is best—one that preferentially deposits oil on the surface to be polished. In general, this means cationic emulsifiers, or selected non-ionic ones. The latter are preferred because they give better emulsion stability. UNION CARBIDE Silicone Emulsions are, of course, made with non-ionic emulsifiers—*and are the most stable silicone emulsions made.*

There are other considerations too: wax/silicone balance, selection of waxes, solvents, secondary emulsifiers, and propellants. We've got research facilities in all of these, and we'll discuss them in future issues (or see your Silicones Man now and discuss them personally).

AEROSOL FOAM FURNITURE POLISH

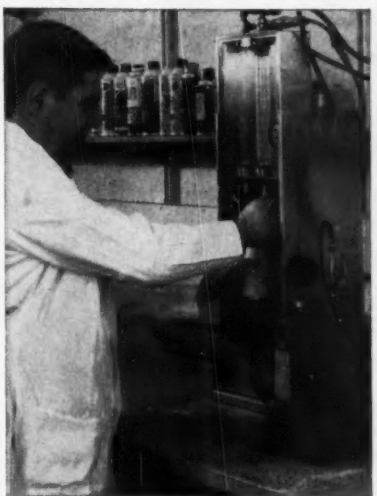
Aerosol formulations, long a specialty of UNION CARBIDE's Silicones Division, consist basically of silicone, wax, an emulsifier, and either isobutane or UCON brand fluorinated hydrocarbon as a propellant. Here is a typical formula for an aerosol foam furniture polish that is easy to use and gives a lasting luster:

FORMULA 343A

	% By Weight
UNION CARBIDE L-45 Silicone Oil 350 cstks.	3.0
"Crown" 23 Wax	2.0
Oleic Acid	2.0
Triethanolamine	1.0
Mineral Spirits	20.0
2% Aqueous "Carbopol" 934 Solution	10.0
Water	59.3
Triethanolamine Lauryl Sulfate	2.3
Non-ionic Alkylolamide ("Hyonic" FA-40)	0.4
	100.0

UCON Propellant 12 : 18.5 weight per cent based on polish
Can Pressure : 35-40 psi
Valve : Clayton Standard Flow Foam Type

Each of these ingredients has a purpose—the triethanolamine lauryl sulfate, for instance, is both a foam stabilizer and a detergent. Detailed data are available on all of these, and on mixing, emulsifying and other important operations.



UNION CARBIDE'S vast facilities and experience in chemicals are behind every step in development of silicone formulations to match your needs. Here, a scientist in the aerosol development laboratory tests a newly packaged formulation.

A VAST FUND OF INFORMATION

Studies carried out by UNION CARBIDE's Silicones Division have been broad in scope and have resulted in many formulas for polishes of all kinds. In addition to its own research and development, the division has also drawn on the vast resources of the parent company and its related divisions for added technological and chemical information.

If polishes are your concern—or problem—by all means see your UNION CARBIDE Silicones Man. Remember, too, he is also an expert in hundreds of other uses of silicones in chemical processing and products. Whatever your needs in silicones, he can fill them. Use the coupon below.

UNION CARBIDE

SILICONES

UNION CARBIDE and UCON are registered trade marks of Union Carbide Corporation.

Silicones Division
Union Carbide Corporation
Dept. GI-4104
30-20 Thompson Ave., Long Island City 1, N.Y.

In Canada: **Union Carbide Canada Ltd., Bakelite Division, Toronto 12.**

Please send me data on_____

_____

NAME_____

TITLE_____

COMPANY_____

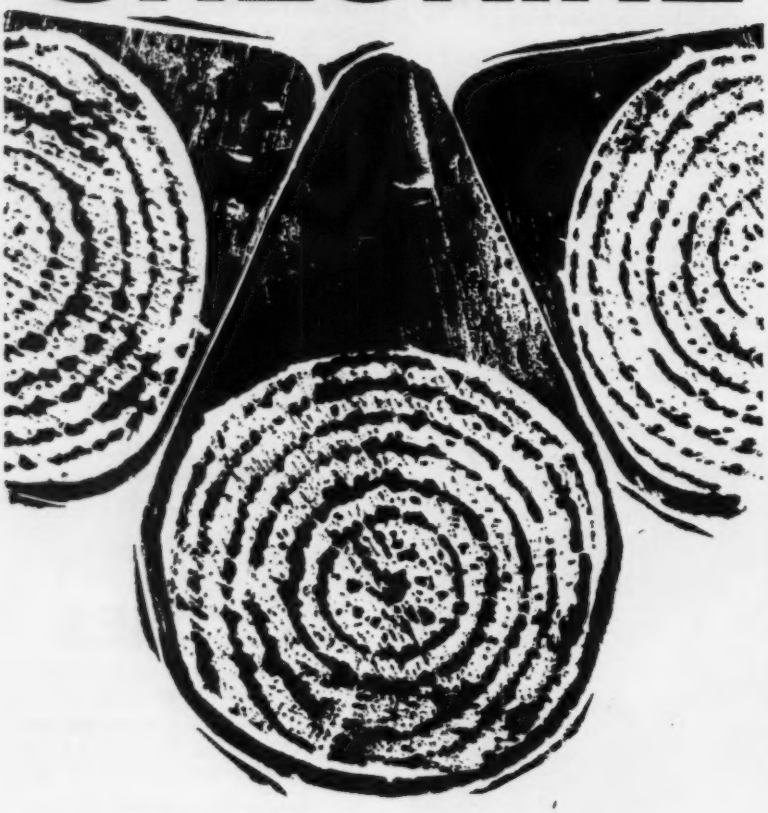
ADDRESS_____

CITY_____ ZONE____ STATE_____

The first rail delivery of chlorine in single-unit tank cars was made from a Pennsalt plant in 1909. Today, modern new cells, expanded capacity and widespread distribution facilities continue Pennsalt's half-century of leadership in chlorine production.

Pennsalt chlorine, caustic soda and sodium chlorate are used by hundreds of pulp and paper mills and convertors throughout the country. Handling, storage and application aid available on request. Industrial Chemicals Division, PENNSALT CHEMICALS CORPORATION, Three Penn Center, Philadelphia 2, Pa., 2901 Taylor Way, Tacoma 2, Wash.

CHLORINE



The great pulp and paper industry, extending from Florida to the Pacific Northwest, is one of many served by Pennsalt with quality chemicals for over half a century.

Industrial Chemicals Division

SALES OFFICES: APPLETON • ATLANTA • CHICAGO • DETROIT
LOS ANGELES • NEW YORK • PHILADELPHIA • PITTSBURGH
PORTLAND • ST. LOUIS • SAN FRANCISCO • TACOMA

FOREIGN SALES: INDUSTRIAL QUÍMICA PENNSALT, MEXICO CITY
PENNSALT INTERNATIONAL, PHILADELPHIA, PA.

Pennsalt Chemicals®
ESTABLISHED 1850

polymer, Experimental Thickener ASE-95, for thickening aqueous and polar-solvent systems such as those commonly used for paint, paper and specialty coatings.

When the material is diluted with water and neutralized with a suitable base, each emulsion particle dissolves and the solution clarifies and becomes very viscous. A 20-fold dilution, after neutralization, for instance, gives a solution with a hundredfold higher viscosity than that of the original emulsion.

The thickener can be added directly to the system to be thickened without preneutralization, and *in situ* thickening will occur if the system contains enough free alkalinity to neutralize the ASE-95. This avoids handling of large volumes of dilute viscous solutions.

Besides being touted as a thickener for aqueous and polar-solvent systems, the product is said to be an effective suspending agent for pigments, abrasives and other finely divided solids, and as a stabilizer for compounds based on nonionic surface-active agents.

'Pushbutton Beauty'

Entry blanks and rules for the Chemical Specialties Manufacturers Assn.-sponsored "pushbutton beauty" contest are now available from CSMA (50 East 41st St., New York). The Annual Aerosol Package Contest will be held in conjunction with CSMA's 48th annual meeting at Roosevelt Hotel, New York, Dec. 4-6.

Awards will be made on the basis of product package design only. Entries are open to any aerosol-brand owner or marketer and are not restricted to members of CSMA. There are no entry (or other) fees, and marketers may compete in as many classes as desired.

Competition and awards will be in 15 aerosol groups: automotive; insecticides, repellants and mothproofers; room deodorants; paints, protective coatings and paint removers; other household products (glass cleaners, rug shampoos, starches, etc.); shave products; hair preparations; perfumes and colognes; other personal products; foods; horticultural products; medical products; veterinary and pet products; industrial products (lubricants, stencil inks, etc.); and foreign products.

Periodic heat tests gauge color stability of ACINTOL® FA 3 Fatty Acid.

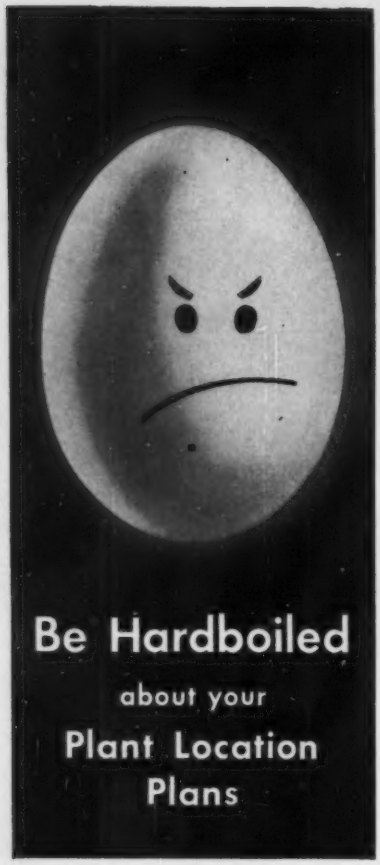
Arizona takes extra steps to bring you the most color-stable fatty acid

Arizona offers the lightest fatty acid at its price and ACINTOL® FA 3 keeps its color characteristics through heat processing. It is heat-tested at several points during production for color stability. The finished product is stored in aluminum tanks, under a protective blanket of inert gas. Tank cars and shipping drums have the gas blanket and a special lining to prevent color degradation. **Result: lightness that lasts—your assurance of optimum color characteristics in your own product. New ACINTOL FA 3 is also low in unsaponifiables and rosin acid content, and its high quality uniformity eliminates the need for costly formulation adjustments.**

For data sheets, write Arizona Chemical Company, 30 Rockefeller Plaza, N. Y. 20, N. Y.

World's Largest Supplier of Tall Oil Chemicals

ACINTOL® Tall Oil Products, ACINTENE® and ARIZOLE® Terpene Products



We like to work with hardboiled plant location people. The harder-boiled the better. That's because we can prove the Toledo-Northwestern Ohio area offers unmatched opportunities for Chemical Process Industries. Our proof is contained in a survey of the area by Fantus Research, Inc., one of the nation's foremost industrial location services. For more information, write or call R. E. Johnson, Manager, Industrial Development Department, The Toledo Edison Company, Toledo 1, Ohio

THE TOLEDO EDISON COMPANY
an investor-owned electric light and power company serving Northwestern Ohio

PRODUCTS

Flower Dryer: Davison Chemical Division of W. R. Grace has developed a silica gel product suitable for drying flowers. Flowers dried with the gel are said to last several months, retain their original colors. Plantabbs Corp. (Baltimore) will market the product under the name Flower-Dri. A 1½-lb. package costs $2.95; a 5 lb. package, $6.95.

•

Marking System: A new ink called All Mark has been developed by Weber Marking Systems (Mt. Prospect, Ill.) to be used in a handprinting device that prints from a stencil (either typed or handwritten). The ink will mark nonporous surfaces such as glass, metal, coated cartons etc., dries in a few seconds. The ink is available in blue, green, red, orange and yellow.

•

High Build Coatings: Carboline Co. (32 Hanley Industrial Ct., St. Louis, Mo.) has developed a high-build urethane coatings system called 132 Build Coat. It consists of a 2-mil prime coat followed by a 6-mil film coat, sealed off with a 1½-mil finish coat. The coating system is intended for heavy duty maintenance areas such as tank exteriors, pump bases and on structural steel.

•

Ceramic Binder: Narmco Industries, a subsidiary of Telecomputing Corp. (San Diego) has developed a ceramic binder material that is said to reduce sintering temperature and time requirements. The material, called Pycerox, is added to conventional ceramic powders used in liquid-phase sintering in amounts of 10-40% of the final mixture. When added to powdered beryllium oxide at 10-20% levels, for example, it cuts sintering time from 60 minutes at 3000 F to about 5 minutes at 2000 F, according to the company. It can also be used in binding ceramic flakes, and has possible application in production of continuous ceramic fibers.

•

Bag in a Box: Bemis Brothers Bag Co. (St. Louis, Mo.) has developed a disposable paper carton with a film liner for shipment of liquid or semi-liquid products. It's called the Liquatainer, consists of a pliable film bag inside a bleached food board carton. A pour spout is an integral part of the package. Contents can be frozen without damaging the package.

•

Sun Tan Sponge: Angelique Co. (Wilton, Conn.) is marketing its sun tan lotion, Sun Up, in a ready-to-use sponge applicator. The one-application sponges are wrapped in foil-lined envelopes, 15 in a carton for $2.

•

Water Repellant: Argus DWR, a water repellant that resists both dry-cleaning and laundering is being sold by Argus Chemical Corp. (633 Court St., Brooklyn, N.Y.) for use on fibrous materials, e.g., cotton and wool; and man-made fibers e.g., nylon, Dacron and Orlon. It's supplied as a 45% solids-emulsion polymer.

•

Heat Resistant Adhesive: A one-component, pressure-sensitive adhesive, Bostik 2105, is being marketed by B. B. Chemical Co. (784 Memorial Drive, Cambridge, Mass.) for use on automotive, electrical and similar tapes. A natural rubber base type, the adhesive resists high temperatures (300 F) without lifting or creeping. The adhesive (40% solids) is ready to use, is applied by knife coating.

•

Plasticizer: Rubber Corp. of America (New South Rd., Hicksville, N.Y.) has developed a new ester-type plasticizer, Plasticizer TM, a tri-ester of trimellitic anhydride. Molecular weight of the triisooctyl trimellitate plasticizer is 546. This high molecular weight provides low volatility while the three ester groups give good solvation and compatibility, according to the company.

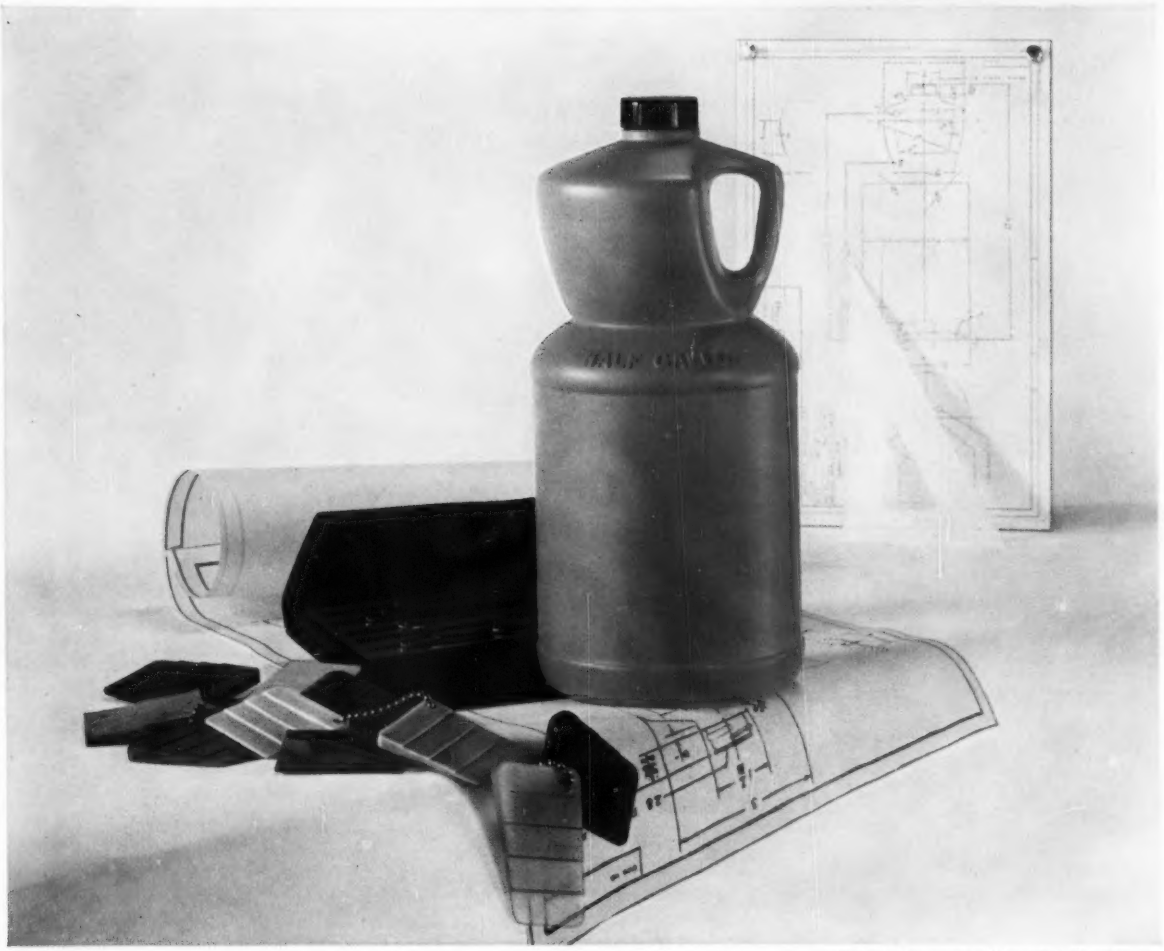
•

Nontoxic Stabilizers: A new group of low-odor, nontoxic stabilizers for use in vinyl formulas (including rigids) is being marketed by Ferro Corp. (Cleveland, O.) under the tradenames 765A, B, and C. The stabilizers have been accepted for use by the Food and Drug Administration. The calcium and zinc containing materials are supplied as free flowing white powders.

•

Meat Film: Goodyear Tire & Rubber Co. has developed a new shrink-tight film, called Vitafilm ST, for packaging frankfurters. It's priced at 86¢/-lb. in 1-mil thicknesses, has a yield of 21,500 sq.in./lb.

OWENS-ILLINOIS
SKILL IN PLASTICS
TAKES MANY SHAPES
TO SERVE YOU



A new O-I design created by Dwight Fuerst.

New line of plastic bottles with a "custom" look

Here is a brand-new line of plastic bottles created by Dwight Fuerst, well-known package designer. It includes quarts, half-gallons and gallons, with a wide choice of colors. The half-gallons and gallons have built-in handles. With your labels and your choice of colors and caps these new bottles could be distinctively yours.

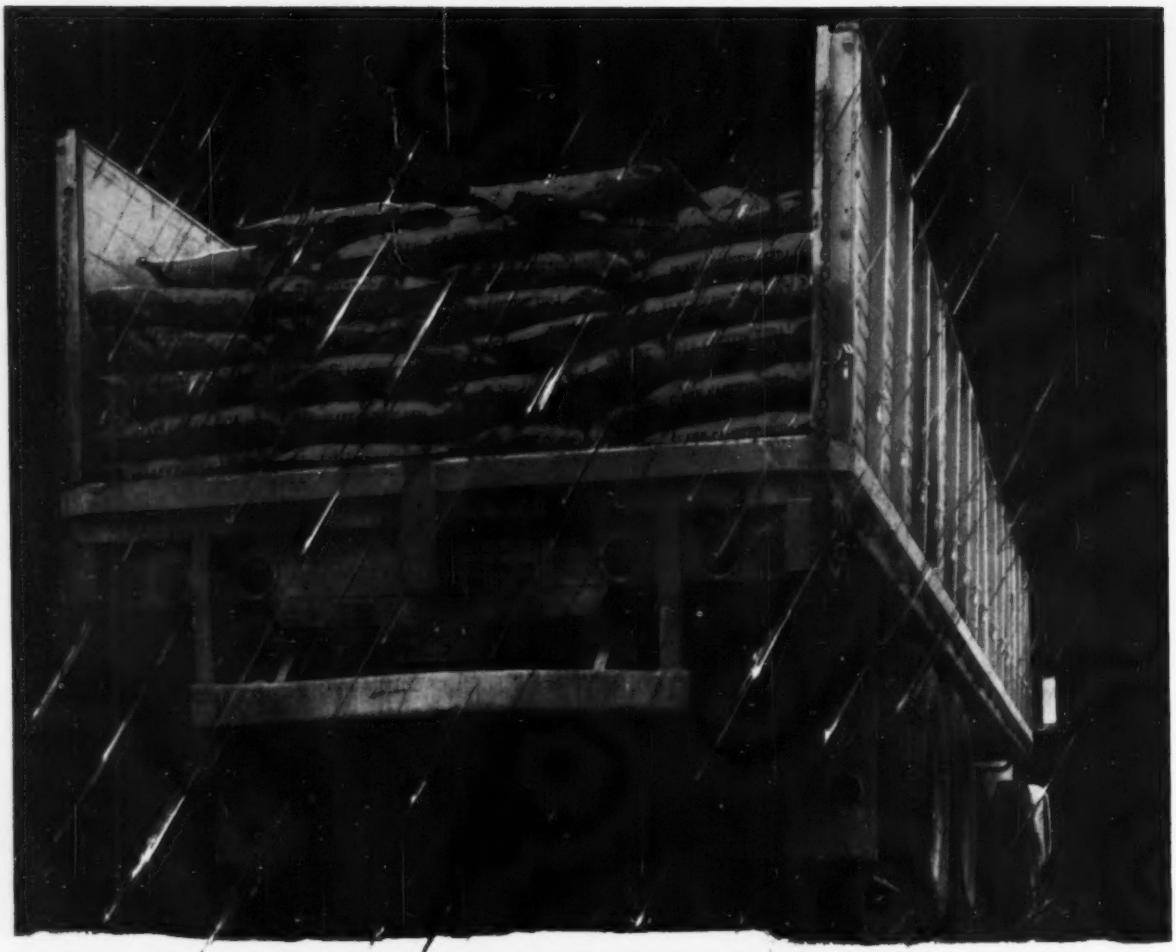
They are designed for bleaches and other chemically active liquids, such as shampoos . . . lotions . . . detergents . . . you name it.

In addition to their design features, the new containers have the advantages of polyethylene plastic. They are lightweight, durable, and nearly as easy to dispose of as paper bags.

Get in touch with your nearby O-I office or write directly to us for information.

PLASTIC BOTTLES
AN (I) PRODUCT

OWENS-ILLINOIS
GENERAL OFFICES • TOLEDO 1, OHIO
PACIFIC COAST HEADQUARTERS • SAN FRANCISCO



FRONTIER CAUSTIC SODA Carries its own umbrella!

Caught in the rain with no tarpaulin . . . but the load is safe! For **FRONTIER** Caustic Soda carries its own umbrella. Its exclusive service-proved 50 and 100-lb. bags are heavily coated with moisture-proof polyethylene, sewn and heat-sealed top and bottom. Inside, a waterproof plastic insert features a valve-type "breather" seal that prevents entrance of moist air . . . keeps the caustic from caking. Not one failure has been reported on this new improved bag in oilfield use — many exposed to rain and snow all winter. Specify Frontier Caustic Soda . . . in the weatherproof bag. Frontier Chemical Company, P. O. Box 545, Wichita 1, Kansas.

FRONTIER CHEMICAL COMPANY

division
VULCAN MATERIALS COMPANY

Technology
Newsletter

CHEMICAL WEEK
September 9, 1961

General Tire's claim to invention of High-Mooney oil extended rubber received another boost last week: notification by the British Patent Office that it would grant General a patent on the development. The claim was filed in '51 and the application published in '55. Polymer Corp. (Sarnia, Ontario) opposed the patent on grounds that the invention was not patentable. The British action follows similar approval by the Swedish government last month (*CW, Aug. 19, p. 26*).

Almost all users of synthetic rubber employ the technique. Other producers, however, contend that the development was perfected while the government owned synthetic rubber plants and should be available to all purchasers of these plants. At present, U.S. Rubber and Goodyear are being sued by General; Firestone in turn is suing General.

•

A new trend in titanium dioxide processing is firming up: It's oxidation of titanium tetrachloride using oxygen or an oxygen-enriched air. Nobody is saying much about it at present. But Du Pont is almost certainly using the method at its big plants in Edge Moor, Del., and New Johnsonville, Tenn. (*CW, July 22, p. 70*). Cabot Corp. is believed moving ahead with plans to enter titanium dioxide using this approach. And National Lead is quietly building a pilot plant.

In the conventional approach to making the product, ore is digested in sulfuric acid to form a titanyl sulfate. This is hydrolyzed to hydrous dioxide which is calcined, ground and finished. The new tetrachloride approach has long been touted as an attractive process and a number of firms have investigated it. Du Pont has patented versions of the process (e.g., U.S. 2,559,638; 2,670,275). So has Cabot (Brit. Pat. 707,389). Foreign firms, including British Titan Products and companies in France and Germany have looked at it too.

Pittsburgh Plate Glass pioneered in the field obtained a series of patents in the early '40s. In '41 for example, it received a U.S. patent (2,240,343) on the broad idea of decomposition of the tetrachloride in the vapor phase, rather than on the wall of the container. And although Du Pont is generally credited with doing the significant commercial development work on the process, it operates under a PPG license. However, the latter's patents are running out and the patent position regarding newer producers is not clear at the moment.

Economics of the process are said to be favorable. Yields are good (approximately 95%) and the resultant product is claimed to be superior to that made via the sulfate. One proponent of the scheme says flatly that the process costs are 5½¢/lb. cheaper than those of the conventional process. But such savings are not apparent from listed prices of

the raw materials and products: It takes 2½ lbs. of tetrachloride (at 20¢/lb.) to make 1 lb. of dioxide (at 25½-26½¢/lb.). Adding oxygen costs and allowing credit for chlorine by-product, it still comes to use of over 50¢ worth of materials to make approximately 32¢ worth of chemicals. Obviously then, success of the process hinges on an integrated operation—recycling the chlorine and economic production of the tetrachloride. Power consumption is relatively high; new plants using the method will probably concentrate near cheap electricity.

For Cabot, the process will be somewhat analogous to the "flame" process it uses to make Cab-O-Sil silica. In this, however, water is the reactant with the silicon tetrachloride (supplied by Stauffer), and hydrogen chloride (sold to National Distillers) is the by-product. Presumably too, the new process will be similar to Cabot's proposed venture into alumina from the chloride.

Which process will American Potash & Chemical employ in its titanium dioxide plant scheduled for Mojave, Calif.? The feeling has been that the firm was holding back, waiting to learn more about the tetrachloride approach. The plant will be in the middle of the desert about 50 miles from Hendersen, Nev. But late last week, the firm revealed it had awarded C. F. Braun the contract for engineering design. (Great Britain's Laporte Titanium, Ltd. is supplying process information and know-how.)

Best guess then is that the company will go ahead with the sulfate process. The reasons for its decision to locate in the desert are not clear. One possibility: It may hope eventually to develop an ore source from the titanium-bearing sands known to exist in the area. Du Pont reportedly looked at these sands ten years ago.

•

A new four-way agreement may help clear platinized titanium anode confusion for chlorine production. Imperial Chemical Industries (London), Magneto-Chemie N.V. (Scheidam, The Netherlands), Amalgamated Curacao Patents Co. (Curaco) and Engelhard Industries (Newark, N.J.) have agreed to pool patents and know-how, jointly develop and extend the use of platinized titanium anodes. Du Pont has already reported on the advantages of platinized anodes in plant trials, however the patent situation has remained unsettled for some time (*CW, Mar. 25, p. 153*).

ICI and Magneto-Chemie have both field for patents covering the use of platinized anodes in brine cells for chlorine production. In fact, Magneto-Chemie is believed to have filed before ICI. Patents have not issued yet in this country, but two patents (616,029) and 644,415) have already issued in Canada. Under the new four-way agreement, Engelhard will have exclusive licenses to any patents that issue in this country, Canada and Mexico.

NOW MORE MILES TO THE GALLON OF GLYCOL!

Sodium Borohydride Treatments Stretch The Useful Life Of Glycols, Cut Your Costs!

This is an economy angle that's important to consider. Sodium borohydride gives important new "life" to glycols and polyglycols that are contaminated with trace carbonyl impurities . . . quickly, without any complicated reprocessing. Just add small amounts of sodium borohydride powder — or liquid solution (SWS). Within a short time, in some cases less than an hour, most of the unwanted carbonyl is reduced to the alcohol*, like this:

$$NaBH_4 + 4RCHO \xrightarrow{2H_2O} NaBO_2 + 4RCH_2OH$$

If you manufacture glycols, it will pay you to improve the purity of your product by adding sodium borohydride directly to the process stream — or, by using sodium borohydride pellets for fixed bed purification. Doing it either way will give you the purity you want — without adding any significant cost to your overall process!

JUST PUBLISHED — TECHNICAL BULLETIN 509

To get your copy — and technical service, if you wish — write, wire or call today.

*Patent #2683721 — owned by Metal Hydrides Incorporated

PIONEERS IN HYDRIDE CHEMISTRY

Metal Hydrides Incorporated

219 CONGRESS STREET, BEVERLY, MASSACHUSETTS

AIR REDUCTION ANNOUNCES A MAJOR CONTRIBUTION TO THE INDUSTRIAL GROWTH OF THE DELAWARE VALLEY

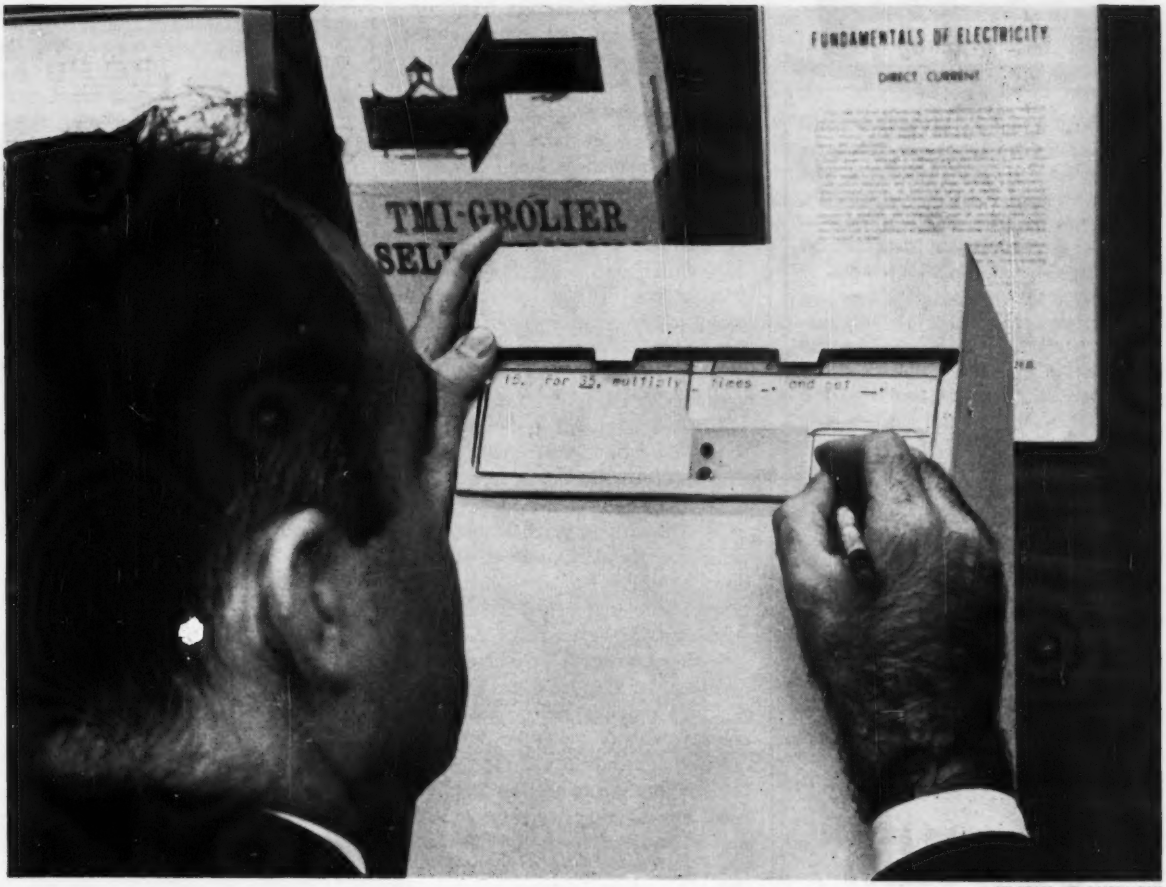
Tonnage quantities of pipeline oxygen, nitrogen and hydrogen will soon be available from Air Reduction's huge, industrial gas center now under construction at Claymont, Delaware – in the heart of the Delaware Valley industrial complex.

The nation's longest nitrogen pipeline, and an oxygen pipeline, will originate at the new Airco plant and cross the Delaware River into New Jersey where it will branch to the north and south. Initially, large quantities of nitrogen will be piped to Shell Chemical at Woodbury, N. J., and duPont at Deepwater, N. J.; and both oxygen and nitrogen will be piped to SunOlin Chemical on the Delaware side of the river.

The oxygen and nitrogen will be available to future users anywhere along these pipelines. In addition to the plant site on the Delaware side of the river, a larger plant site has been acquired by Air Reduction on the New Jersey side for future growth.

AIRCO®

AIR REDUCTION
COMPANY, INCORPORATED
150 East 42nd Street, New York 17, New York



CW PHOTO—W. ROSENBLUTH

Teaching machine presents small frame of information with question for trainee's written response.

On the Program: New Training Savings

Last week more than 450 management men—including many from chemical companies—jammed into an auditorium in New York's Astor Hotel and spilled over into adjoining closed-circuit television rooms for the American Management Assn.'s conference on programed learning and teaching machines.

The lure for industry: latest word on a new training technique that boosts employee learning over 25%, cuts classroom training time by a similar percentage. In addition, the technique can replace the classroom instructor with individual tutors that may be either machines, such as the one pictured above, or specially designed text- or workbooks. And, it may permit training courses to be given to only one or a few trainees —a condition under which training courses often could not be economically justified in the past.

Schools such as Harvard University, University of Pittsburgh and University of Pennsylvania and companies such as International Business Machines, Eastman Kodak and Du Pont have developed experimental programs. And early trials have been so successful that suppliers of programed learning materials are already jumping into the field at a dazzling rate.

Robert L. Chapman, manager of training and simulation at Thompson Ramo Wooldridge's Intellectronics Laboratories (Canoga Park, Calif.), estimates that there are 35 or more machines and 100 programs now available—and that by '65 the market may hit $100 million.

Leonard C. Silvern, education and training research director of Hughes Aircraft Co.'s Videosonic Systems (Culver City, Calif.) reports that there are at least nine makers and sellers of machines—and they are increasing at a rate of about two/week. In addition there are at least 37 firms that make machines and supply programed lesson plans as well—and they are increasing at a rate of about four/week.

Slower Pace: Chemical companies are proceeding at a more cautious pace than machine and program suppliers, however. The results and potential uses are intriguing, but programed learning is too new for firm commitments, and no courses are being given on a routine basis.

Active programing of courses has

W·G·S "HYWAX-120"
saturated
FATTY
ALCOHOL
ESTER

A crystalline, wax-like, sperm oil derivative now finding wide usage as a low-cost oiliness agent. The ideal additive for plastics, lubricants, drawing compounds, rust inhibitors, detergents, polishes, textile softeners — and an effective chemical intermediate for the formulation of many other products.

"HYWAX-120" is composed of fatty alcohol esters (Cetyl and Stearyl) of fatty acids (Myristic, Palmitic and Stearic), with a small amount of glycerides. Soluble in organic solvents above its melting point (115-125°F) and in petroleum oils, but insoluble in alcohol. Low in free fatty acid (2.0% max.), "HYWAX-120" is compatible with fats and waxes — and non-corrosive.

Data sheet, prices and samples on request.

What a whale of a difference "HYWAX-120" makes!

WERNER G. SMITH, INC.

1730 TRAIN AVENUE · CLEVELAND 13, OHIO
Phone: TOwer 1-3676

SODIUM SULPHATE

(Anhydrous)

SALT CAKE

PRIOR CHEMICAL CORPORATION
420 Lexington Avenue
New York 17, N. Y.

been under way for about two years. IBM and Kodak—probably the most advanced firms in industrial programing—have been developing courses for a shorter time. IBM began an exploratory project in early '60, assigned three program writers to develop three programs for its equipment maintenance men. The programed courses have been given to several groups. The first group (75 maintenance men) completed a course 27% faster with better test grades (a 95% average vs. 86% average) than a group taking an ordinary course used for control. For a later group, the programed course was improved; it was completed 47% faster than an ordinary course with test results similar to the earlier experiment.

Kodak assigned a physicist to full-time programing about eight months ago. The company has used the technique to teach courses such as basic photography, sensitometry, statistics and electronics to several hundred employees. It has not developed any programs for its chemical operations as yet. But James S. Bruce, director of training, sees no reason why courses can't or won't be developed.

The maintenance consulting group of Du Pont's Engineering Dept. has been investigating programed learning for more than a year. It developed an experimental program in blueprint reading, which it gave to six trainees last spring. The course was completed in about 25% less time and trainees learned about 25% more than a control group in an ordinary course. An additional group of 12 trainees has been tested, with similar results.

Deceptive Simplicity: Companies investigating and experimenting with programed learning have faced a number of perplexing problems so far. One of the first is the deceptive simplicity of the concept of a programed course (*see right*).

In the programed learning technique, the trainee is presented with small quantities of information (usually a sentence or two—which programers call frames). During each exposure the trainee answers a question and is shown within a matter of seconds by the teaching machine or book whether the response is correct. The small quantities of information are often cued to help the trainee ar-

text continues on p. 95

A Short Course In Programed Learning

One of the simplest ways to l about programed learning is to the sample program below, which m be part of a basic course in bear for maintenance mechanic training.

If the program were incorporated a teaching machine similar to the shown on p. 93, the questions wo appear on a paper tape that can moved past a window in the mach After writing the appropriate answer the blank space provided on the t the student would move the tape ward to the point where the co answer would be found along with next question.

In the sample program below, correct answer to Question 1 wi found on p. 96 along with Questio and instructions for completing program.

QUESTION 1: Although plain be ings are strong and will withstan large amount of abuse in service, t fail occasionally. It is important to cognize faulty _____ bearings cause their failure can be sens (Turn to p. 96 for answer and for Qu tion 2)

Answer to Question 2 (p. 96): p

QUESTION 3: Frequently failures sult from a combination of cau which makes determination of the ba _____ of failure difficult. (Turn p. 96 for answer and for Question 4

Answer to Question 4 (p. 96): lub cant

QUESTION 5: However, a lubric that is too _____ may not be ca ble of carrying the load. (Turn to p for answer and for final question)

Answer to Question 6: plain.

Note: Cheating by reading the swer to the next question before t ing the page to read the question n not be harmful. Educators have yet decided whether cheating impa learning when the programed te nique is used. However, it is not usu possible to cheat when using a tea ing machine.

PRODUCTION

ve at the correct response. The rainee proceeds at his own pace. And ecause of immediate answer feedack, errors are cleared up before he roceeds to the next step.

As a number of speakers at the AMA conference pointed out, the urden of responsibility is on the ourse programer. If a course isn't ffective, it is the fault of the proraming.

The relatively simple looking rames of typical programed learning ourses are often produced at a slow ate—about 1½-2 frames/hour. IBM ound that its programers were producing at a rate of about 100 frames/month at first, but within three months had doubled their speed. Once a program is tried out, the trainees' responses to questions are analyzed, and to improve the program.

Which System? A company must also decide between two systems of programing—linear or branching. The linear system, developed by B. F. Skinner of Harvard, has usually followed the pattern of one or two sentences with blanks that must be filled in by the student. The student is led directly from one frame to the next.

The branching system was developed by Norman Crowder, technical director of training systems for U.S. Industries, Inc.'s USI Educational Science Division (Goleta, Calif.). The most characteristic feature is presentation of a complete paragraph followed by a multiple-choice question. If the trainee selects the incorrect answer, he is immediately led to a side paragraph. If he answers this question correctly, he is usually returned to the original paragraph, given another chance to answer it correctly before proceeding with the lesson.

At the present stage of development in programed learning, there is considerable debate on the merits of each system. For example, at the AMA conference David Padwa, president of Basic Systems, Inc. (New York), pointed out that the branching system can lead to a great deal of confusion in shunting back and forth between frames. And with a multiple-choice question, the trainee is given the alternatives, has only to make a choice.

Crowder, on the other hand, points out that trainees often require an explanation of why their answer was incorrect. The linear system does not

GLYCOL ETHERS

"Cellosolve"* Solvent—Methyl "Cellosolve"
Butyl "Cellosolve"*—"Carbitol"* Solvent
Butyl "Carbitol"*—Methyl "Carbitol"*

* Reg. Trade Mark

GLYCOLS
GLYCOL ETHERS
CHLORINATED SOLVENTS
KETONES • ESTERS • AMINES
PLASTICIZERS • AROMATIC SOLVENTS
SURFACE ACTIVE AGENTS • ALCOHOLS
ALIPHATIC NAPHTHAS • POLYETHYLENE GLYCOLS

CS CHEMICAL SOLVENTS, INC.
60 PARK PLACE, NEWARK 2, N. J.
WOrth 2-7763 (N.Y.) MArket 2-3650 (N.J.)

WINTHROP NOW OFFERS

PAPAIN

• STANDARDIZED
• STABLE
• PURE

Send for quotations and free sample TODAY!

CW-991

Special Chemicals Dept.
Winthrop Laboratories,
1450 Broadway, New York 18, N.Y.

Papain interests us. Please send sample and quotations.

Name .....
Company .....
Address .....

HARCHEM

SEBACIC ACID

Can Give Your Dreams Reality

Got a product dream that is proving pretty illusive? Pin it down with Harchem 99% Sebacic Acid. Has greater straight chain length, higher purity than any other dibasic. Gives plasticizers, polyesters, paint, lubricants, coatings and nylon positive freedom from side-chain reactions — absolute protection against structural changes due to temperature, moisture or physical or chemical abuse.

You'll find Harchem Sebacic Acid imparts a backbone of stability to products that makes them front-runners in the race for sales.

Send for sample or consult
CHEMICAL MATERIALS CATALOG
Pages 159-161

THE KEY TO HARCHEM® BETTER PLASTICS

HARCHEM DIVISION
WALLACE & TIERNAN INC.
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY
IN CANADA: HARCHEM LIMITED TORONTO

give this. Also, for relatively complex problems, (e.g., in process or system trouble shooting) there is often no correct answer—only alternatives that may ultimately lead to a solution.

Arthur A. Lumsdaine of UCLA's Dept. of Education feels that neither system is exactly on target. He told AMA conferees that if he had to make a choice today he would probably pick Skinner's linear approach, but only because the art of programing has been "conceived but is not yet fully born."

Kodak's Bruce says his firm will use any type of program, provided it will produce learning in the student. Kodak has used Teaching Machines Inc.'s (Albuquerque, N.M.) course in statistics—a linear type program; Crowder's USI course in electronics —a branching program—has also been used. A number of training directors and programers point out that the two systems can be combined.

Machine vs. Paper: Either system can be used with teaching machines or with textbooks or workbooks. Kodak has tried both; Bruce favors the machine because a text tends to become bulky, unwieldy.

Experiments so far indicate that it makes little difference from a learning standpoint whether the machine

Programed Learning Course (see p. 94)

Answer to Question 1: plain.

QUESTION 2: Plain bearings do fail as abruptly as ball bearings. B the failure is just as serious whet the bearings are _____ or ball ty (Turn back to p. 94 for answer and Question 3)

Answer to Question 3: cause

QUESTION 4: One of the causes failure of plain bearings may be use of incorrect lubricant. If a _____ of too heavy grade is used, it m cause overheating and result in ea bearing failure. (Turn back to p. 94 answer and for Question 5)

Answer to Question 5: thin

QUESTION 6: A lubricant that is heavy or too thin may be the cause early failure of a _____ bearin (Turn back to p. 94 for answer)

paper approach is used. And, according to John L. Hughes of IBM's applied personnel research section, the latest experiments show that it doesn't seem to make any difference whether the answer is written or not. Tests show that learning retention builds up over a period of time, this could result in a cost savings in programed learning supplies.

Costs: At the present time machines can be purchased at prices from less than $10 to about $5,000. One of the simplest, Grolier, Inc.'s Min/Max (Grolier and TMI have joined forces, for a programed learning package through Teaching Materials Corp., New York), costs $20.

The Min/Max has been used in Du Pont's experiments and by several other firms. One complaint about the operation (program sheets are pushed through the machine using a pencil eraser) has been overcome with a new model that has a roller and a special answer-recording tape.

Commercial programs are generally priced between $5-20. But company programs must often be specially developed on an individual basis that adds to cost.

And, specialization may even narrow down to individual plants. For example, Dow Chemical's Midland Division, which is studying the potential of programed learning for its employees, finds that even in a very large plant many of the courses are so highly specialized that there may be too few trainees to justify the cost of programing. Duane Brooks of Midland's education department says that certain courses—e.g., Du Pont's experimental blueprint reading course—may be sufficiently basic to justify programing.

Procter & Gamble, which is also studying programed learning's potential, feels that trials may be worthwhile in basic statistics, mechanical training and employee benefit and orientation programs.

To the firms that are already experimenting with programed learning one thing is clear: it is not a universal replacement for other methods of training. To some, it is also clear that programed learning is so new that the machines, programs and methods now advocated will be replaced within a few years. But programed learning's principles are so basic that they are likely to be here to stay.

LOOKING FOR A CATALYST FOR THE POLYMERIZATION OF VINYL CHLORIDE?

TRY **ALPEROX C**®

SPECIFICATIONS.

Lauroyl Peroxide	95.0%	(Min.)
Active Oxygen	3.76%	(Min.)
Free Fatty Acids as Lauric Acid	1.5%	(Max.)
Alkaline Soaps as Calcium Laurate	1.5%	(Max.)

THERMAL DECOMPOSITION.

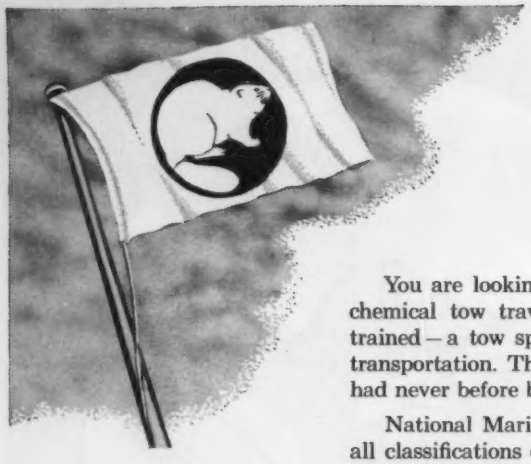
Material	Solvent	Temp. °C.	Half Life in Hours
ALPEROX C	Benzene	100	0.1
Benzoyl Peroxide	Benzene	100	0.33
ALPEROX C	Benzene	70	3
Benzoyl Peroxide	Benzene	70	12

ALPEROX C (Technical Lauroyl Peroxide) is the preferred catalyst for the suspension polymerization of vinyl chloride. Concentrations of 0.1 to 1.0% confer greater heat stability on the final product and facilitate higher conversion velocity. As a catalyst for curing polyester resins, it is especially applicable to the production of small, clear, transparent castings, setting at a temperature of 60° to 80°C. For cold setting with tertiary amines as accelerators, less discoloration occurs than when using benzoyl peroxide.

WRITE FOR DATA SHEET

LUCIDOL DIVISION

WALLACE & TIERNAN INC.
1740 MILITARY ROAD
BUFFALO 5, NEW YORK



*The most sensitive products travel SAFE and CLEAN on the Beaver Flag Line ...*NATIONAL MARINE

You are looking forward from the pilothouse of a National Marine highspeed chemical tow traveling up the Mississippi. You are watching a man specially trained – a tow specially designed – give a customer high-quality, low-cost water transportation. The barges are loaded with high-purity chemicals, some of which had never before been transported by barge.

National Marine's trained personnel with modern barges and tows can handle all classifications of chemical products, petroleum and edible oils, in quantities as small as 100 tons... as large as 10,000 tons.

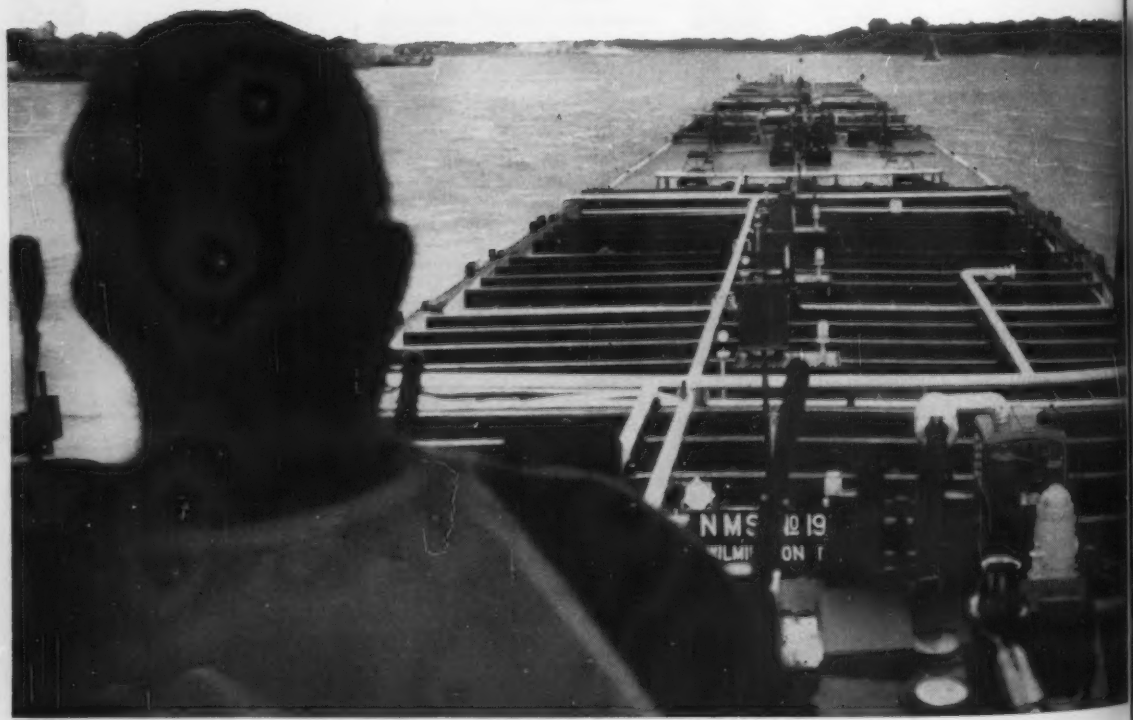
We've solved a lot of difficult problems in our thirty-three years of shipping experience and, given an opportunity, we can solve yours. We'd be glad to relate our experience to your particular line of products and show you how we can assure you of high-quality, low cost water transportation.

Whatever your transportation problem... it pays to talk it over with National Marine. *Brochure on request.*

Operating over the largest geographical area of any contract carrier

NATIONAL MARINE SERVICE
INCORPORATED
General Offices · 21 West Street · New York 6, N. Y. · WHitehall 3-868
Operating and Traffic Offices:
New York, N. Y.; Hartford, Ill.; E. Chicago, Ind.; Houston, Tex.; New Orleans; Perth Amboy, N.

MEMBER OF THE AMERICAN WATERWAYS OPERATORS, INC.



Price of aniline last week tumbled 3¢/lb. in the wake of earlier, similar cuts on benzene (*CW Market Newsetter, July 29*). The aniline price reduction (which brings tank-car cost to 15¢/lb.) was initiated by American Cyanamid; other producers went along with similar cuts with no visible attempt to hold existing price levels.

Aniline output, says one industry spokesman, is running about 80% of capacity, and there has been no significant decrease in demand recently. Seasonal demand for rubber use, tied to tire manufacture for the forthcoming new car season, is characterized as "good, but nothing great."

Will the benzene-aniline price cuts spark other reductions down the line to include aniline derivatives such as nitrobenzene and dimethylaniline? In the past, price adjustments on these items have sometimes come simultaneously or very soon after aniline reductions. Some producers of aniline chemicals admit that prices of nitrobenzene and dimethylaniline could be affected—but in any case none were in a hurry to tip off buyers prematurely.

•

There are signs that competitive pressure from imported trichlorethylene may be easing. Best indication is a ¾¢/lb. price hike on the solvent posted last week by Du Pont. New delivered prices: truckload and carload, drums, 13.25¢/lb.; tank cars, 12¢/lb.

Some competing domestic producers promptly said they would follow Du Pont's lead, others were in no hurry because postings for contract orders were still several weeks off.

Du Pont's action partially restores prevailing '60 prices, which were cut 1½¢/lb. last December (*CW Market Newsletter, Jan. 7*); the reduction then was made to ease pressure from cut-rate foreign-produced trichlor. Apparently the reductions buffered demand for foreign product—although the import volume remains steady, much seems to be going into stockpiles—now at an all-time high on the East Coast.

•

Meanwhile Du Pont slashed the price of adipic acid by 10%, bringing carload and truckload costs down to 29¢/lb. from the previous 32.25¢/lb. Official reason: an attempt to further broaden adipic's use as intermediate for "products other than nylon."

Allied and Monsanto followed quickly with their own 10% cuts on adipic—and Monsanto went one step further by shaving 1¢/lb. off adipate esters.

•

Price of polyvinyl acetate emulsion was reduced 1½¢/lb. on the West Coast by Reichhold in order to equalize West Coast prices with those currently in effect in the Eastern market and to promote increased use. The reduction anticipates increased output on the Coast by two new Reichhold plants—at Azusa, Calif., and at Tacoma, Wash.

Market Newsletter

(Continued)

Japan's paint industry is brushing up on market potentials in the U.S. and Canada, with an eye to exporting synthetic resin paint to the continent. A six-man market survey team representing the Japan Paint Export Promotion Assn. will leave Tokyo Sept. 6 on a 40-day tour of the U.S. and Canada. The team consists of top level executives of four major firms—Dai Nippon Paint, Nippon Paint, Asahi Paint, and Kashu & Co.

Up to now Japan's chief paint market has been Southeast Asia which has been taking only about 1% of annual output. Fiscal '61 production of both oil and synthetic resin paint is 382,000 tons.

The association has already negotiated with the Canadian Embassy in Tokyo to export synthetic resin paint as collateral to linseed oil imports from Canada.

•

Sales of British plastics climbed to a record 158,200 long tons in the second quarter of '61, topping by 10,800 tons the previous record set in early '60. Despite the cheerful second-quarter figures, third-quarter results are expected to show a downturn as the government's new austerity measures begin to affect the economy (*CW Business Newsletter, Sept. 2*). Sharpening competition will also mean continued pressure on profit margins.

The 10% sales increase over the same period in '60 is attributed mainly to higher exports and replacement of imports by British producers. Second quarter exports were 46,300 tons—almost 10% higher than in the same period last year. Imports amounted to 20,300 tons or almost 22% lower than last year.

Sales in the second quarter of '61 broke down as follows: thermoplastics, 103,300 long tons; thermosetting materials, 55,000 tons. Biggest jump was in sales of polyolefins and polystyrene—both 27% higher than a year ago.

•

Total demand for elemental sulfur in non-Communist countries will probably climb to 14.5 million tons/year—perhaps to 16.5 million tons—by '70, Executive Vice President R. H. Feierabend of Freeport Sulphur told Canadian Oil Scouts recently at a Banff meeting. Consumption in all forms was about 18 million long tons in '60—about equally divided between elemental and combined forms.

Freeport's market experts, says Feierabend, figure largest tonnage growth will probably develop in the U. S. and Canada; an increase to 9 million tons in '70, from about 5½ million in '60, is expected.

Sulfur demand in Western Europe (where consumption of elemental sulfur doubled in the past 10 years) should increase about 2.1 million tons to again almost double total use by '70.

Rapid growth in use of elemental sulfur is also expected in relatively underdeveloped areas—particularly in India and Africa where consumption should be more than 2½ times larger in '70 than in '60.

HARCHEM
SEBACIC ACID
Can Give Your Dreams Reality
Got a product dream that is proving pretty illusive? Pin it down with Harchem 99% Sebacic Acid. Has greater straight chain length, higher purity than any other dibasic. Gives plasticizers, polyesters, paint, lubricants, coatings and nylon positive freedom from side-chain reactions — absolute protection against structural changes due to temperature, moisture or physical or chemical abuse.
You'll find Harchem Sebacic Acid imparts a backbone of stability to products that makes them front-runners in the race for sales.
Send for sample or consult
CHEMICAL MATERIALS CATALOG
Pages 159-161
THE KEY TO
HARCHEM
BETTER PLASTICS
HARCHEM DIVISION
WALLACE & TIERNAN INC.
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY
IN CANADA: HARCHEM LIMITED TORONTO

give this. Also, for relatively complex problems, (e.g., in process or system trouble shooting) there is often no correct answer—only alternatives that may ultimately lead to a solution.

Arthur A. Lumsdaine of UCLA's Dept. of Education feels that neither system is exactly on target. He told AMA conferees that if he had to make a choice today he would probably pick Skinner's linear approach, but only because the art of programing has been "conceived but is not yet fully born."

Kodak's Bruce says his firm will use any type of program, provided it will produce learning in the student. Kodak has used Teaching Machines Inc.'s (Albuquerque, N.M.) course in statistics—a linear type program; Crowder's USI course in electronics —a branching program—has also been used. A number of training directors and programers point out that the two systems can be combined.

Machine vs. Paper: Either system can be used with teaching machines or with textbooks or workbooks. Kodak has tried both; Bruce favors the machine because a text tends to become bulky, unwieldy.

Experiments so far indicate that it makes little difference from a learning standpoint whether the machine

Programed Learning Course (see p. 94)

Answer to Question 1: plain.

QUESTION 2: Plain bearings do not fail as abruptly as ball bearings. But the failure is just as serious whether the bearings are _____ or ball type. (Turn back to p. 94 for answer and for Question 3)

Answer to Question 3: cause

QUESTION 4: One of the causes of failure of plain bearings may be the use of incorrect lubricant. If a _____ of too heavy grade is used, it may cause overheating and result in early bearing failure. (Turn back to p. 94 for answer and for Question 5)

Answer to Question 5: thin

QUESTION 6: A lubricant that is too heavy or too thin may be the cause of early failure of a _____ bearing. (Turn back to p. 94 for answer)

or paper approach is used. And, according to John L. Hughes of IBM's applied personnel research section, the latest experiments show that it doesn't seem to make any difference whether the answer is written or not. If tests show that learning retention holds up over a period of time, this could result in a cost savings in programed learning supplies.

Costs: At the present time machines can be purchased at prices from less than $10 to about $5,000. One of the simplest, Grolier, Inc.'s Min/Max (Grolier and TMI have joined forces, offer a programed learning package through Teaching Materials Corp., New York), costs $20.

The Min/Max has been used in Du Pont's experiments and by several other firms. One complaint about its operation (program sheets are pushed through the machine using a pencil eraser) has been overcome with a new model that has a roller and a special answer-recording tape.

Commercial programs are generally priced between $5-20. But company programs must often be specialized, developed on an individual basis that adds to cost.

And, specialization may even narrow down to individual plants. For example, Dow Chemical's Midland Division, which is studying the potential of programed learning for its employees, finds that even in a very large plant many of the courses are so highly specialized that there may be too few trainees to justify the cost of programing. Duane Brooks of Midland's education department says that certain courses—e.g., Du Pont's experimental blueprint reading course—may be sufficiently basic to justify programing.

Procter & Gamble, which is also studying programed learning's potential, feels that trials may be worthwhile in basic statistics, mechanical training and employee benefit and orientation programs.

To the firms that are already experimenting with programed learning one thing is clear: it is not a universal replacement for other methods of training. To some, it is also clear that programed learning is so new that the machines, programs and methods now advocated will be replaced within a few years. But programed learning's principles are so basic that they are likely to be here to stay.

LOOKING FOR A CATALYST FOR THE POLYMERIZATION OF VINYL CHLORIDE?

TRY **ALPEROX C**®

SPECIFICATIONS.

Lauroyl Peroxide	95.0%	(Min.)
Active Oxygen	3.76%	(Min.)
Free Fatty Acids as Lauric Acid	1.5%	(Max.)
Alkaline Soaps as Calcium Laurate	1.5%	(Max.)

THERMAL DECOMPOSITION.

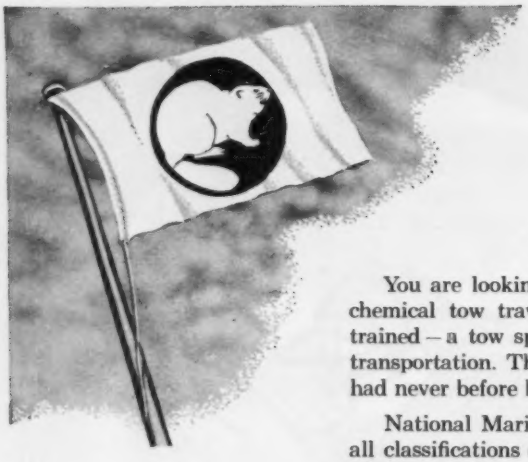
Material	Solvent	Temp. °C.	Half Life in Hours
ALPEROX C	Benzene	100	0.1
Benzoyl Peroxide	Benzene	100	0.33
ALPEROX C	Benzene	70	3
Benzoyl Peroxide	Benzene	70	12

ALPEROX C (Technical Lauroyl Peroxide) is the preferred catalyst for the suspension polymerization of vinyl chloride. Concentrations of 0.1 to 1.0% confer greater heat stability on the final product and facilitate higher conversion velocity. As a catalyst for curing polyester resins, it is especially applicable to the production of small, clear, transparent castings, setting at a temperature of 60° to 80°C. For cold setting with tertiary amines as accelerators, less discoloration occurs than when using benzoyl peroxide.

WRITE FOR DATA SHEET

LUCIDOL DIVISION

WALLACE & TIERNAN INC.
1740 MILITARY ROAD
BUFFALO 5, NEW YORK



The most sensitive products travel SAFE and CLEAN on the Beaver Flag Line ...NATIONAL MARINE

You are looking forward from the pilothouse of a National Marine highspeed chemical tow traveling up the Mississippi. You are watching a man specially trained – a tow specially designed – give a customer high-quality, low-cost water transportation. The barges are loaded with high-purity chemicals, some of which had never before been transported by barge.

National Marine's trained personnel with modern barges and tows can handle all classifications of chemical products, petroleum and edible oils, in quantities as small as 100 tons... as large as 10,000 tons.

We've solved a lot of difficult problems in our thirty-three years of shipping experience and, given an opportunity, we can solve yours. We'd be glad to relate our experience to your particular line of products and show you how we can assure you of high-quality, low cost water transportation.

Whatever your transportation problem... it pays to talk it over with National Marine. *Brochure on request.*

Operating over the largest geographical area of any contract carrier

NATIONAL MARINE SERVICE
INCORPORATED
General Offices · 21 West Street · New York 6, N. Y. · WHitehall 3-8680
Operating and Traffic Offices:
New York, N. Y.; Hartford, Ill.; E. Chicago, Ind.; Houston, Tex.; New Orleans; Perth Amboy, N. J.

MEMBER OF THE AMERICAN WATERWAYS OPERATORS, INC.

Chemucopia!

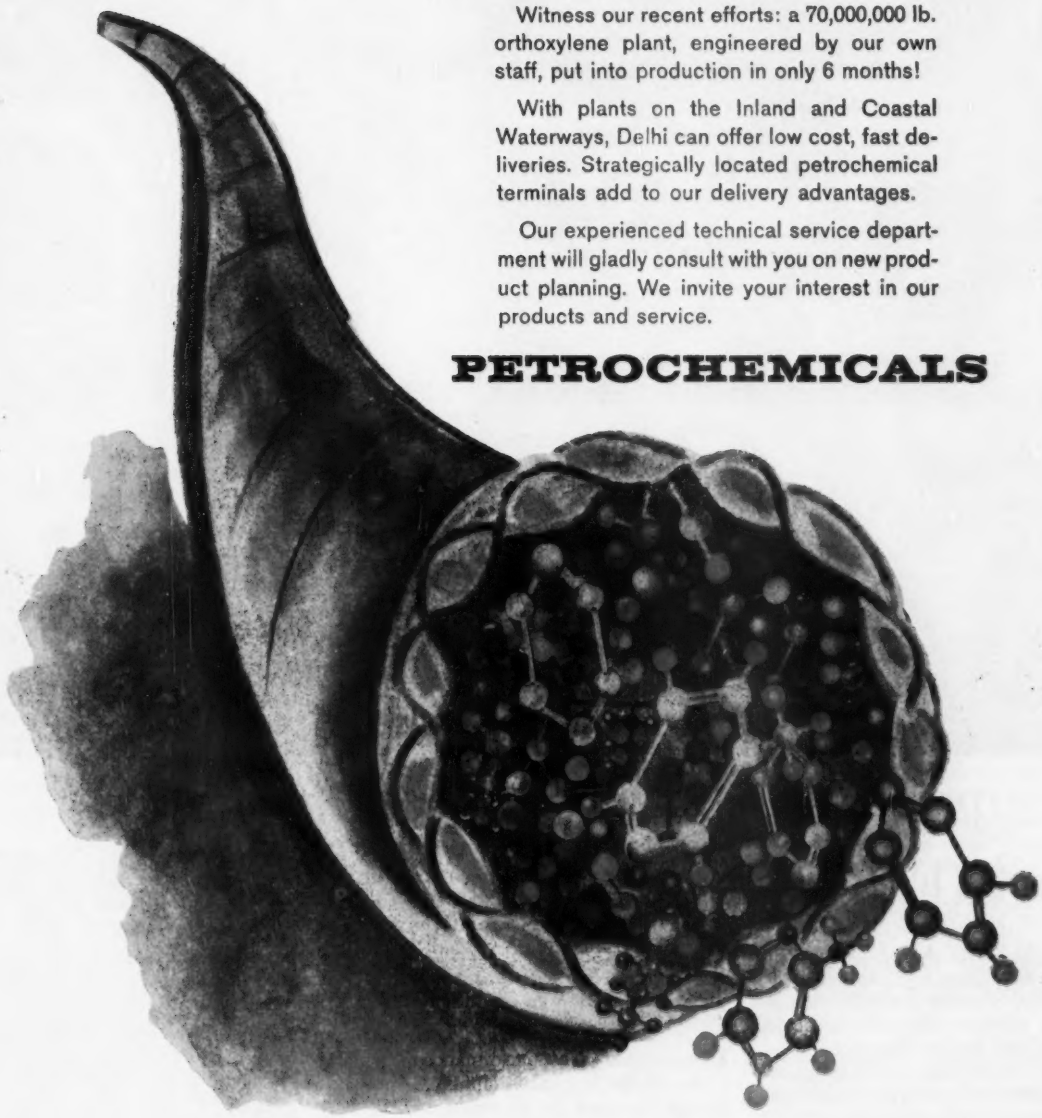
That's Latin slang for "plenty of chemicals." The source of this hydrocarbon luxury is Delhi's diversified petroleum streams and selected feed stocks. Now producing a wide range of aromatic and aliphatic hydrocarbons, Delhi-Taylor can move quickly into production on a number of new petrochemicals.

Witness our recent efforts: a 70,000,000 lb. orthoxylene plant, engineered by our own staff, put into production in only 6 months!

With plants on the Inland and Coastal Waterways, Delhi can offer low cost, fast deliveries. Strategically located petrochemical terminals add to our delivery advantages.

Our experienced technical service department will gladly consult with you on new product planning. We invite your interest in our products and service.

PETROCHEMICALS



DELHI

CHEMICAL DIVISION

DELHI-TAYLOR OIL CORPORATION

FIDELITY UNION TOWER, DALLAS 1, TEXAS • 320 PARK AVENUE, NEW YORK 22, N. Y.
CORPUS CHRISTI • CHICAGO • CHARLESTON, S. C. • BATON ROUGE • HOUSTON

FLUIDICS* AT WORK

TITANIUM CHLORINE COOLER REQUIRES NO MAINTENANCE

If you talked with the people at Stauffer Chemical Company, Niagara Falls, N. Y., you'd find they are not concerned that this chlorine gas cooler is located in a relatively inaccessible spot.

In fact, you'd learn that they placed it here deliberately in order to save production space within their plant.

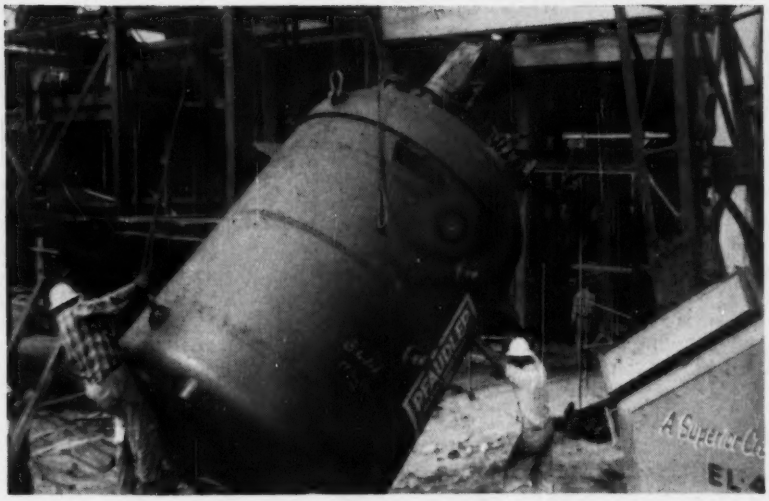
Why? It's made of titanium.

No down time. Installed in Cellhouse No. 1, where a heavy tonnage of chlorine is cooled daily, this 394 sq. ft. Pfaudler® heat exchanger cools chlorine gas from 75° to 40° C. Unlike the other coolers at Stauffer, this titanium unit has required *no* maintenance whatsoever since going into operation late in 1959.

Zero corrosion. This performance record is due to the fact that titanium is completely immune to corrosion by wet chlorine. Because of this, you can locate such coolers without regard to headroom. You don't have to worry about getting at them for inspection, cleaning, or other maintenance.

Sound investment. Moreover, the almost infinite service life of titanium in wet chlorine makes such a cooler an exceptionally sound investment. Compare titanium with other materials, taking into account length of service expected and maintenance required, and the economics of titanium will be apparent.

Availability. Along with titanium, Pfaudler also provides production-sized equipment made of tantalum and zirconium. For the full story, ask for Bulletin 978 —*Titanium, Tantalum and Zirconium Process Equipment by Pfaudler*. Address your inquiries to the address shown on the facing page.



On stream with Pfaudler

This could be your new plant. And one of the men at the site could be from our Field Service group.

His job? Supervising the installation of Pfaudler equipment. Giving expert attention to every detail during uncrating, rigging, erection and hook-up. Assuring operational efficiency.

Such responsibility is the task of our 15-man Field Service staff. The eldest in the group has been servicing Pfaudler equipment for 25 years. The rest? Varying amounts of time. All bring specialized knowledge and skills to the job; the kind that pay off handsomely for you.

These specialists now also offer complete *start-up service*. They check out the equipment, along with your piping —make sure you go on stream with complete confidence.

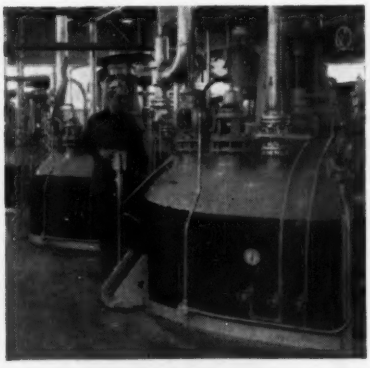
Emergency service is also part of our Field Servicemen's job. Like? When a fire damaged a customer's plant, a Pfaudler tank needed extensive repairs. Our men had the tank removed from the line, shipped it to our plant, and then reinstalled it—*all within a single week*.

These 15 men are strategically located throughout the country. Their services are literally as close to you as your phone.

For more details and cost information, call BEverly 5-1000 in Rochester, New York, and ask for CUSTOMER SERVICE. From then on, *your* problem is ours!

Glasteel helps set records with PVC

High yields, complete protection for product purity, and minimum down time is the story at Cumberland Chemical Corporation's plant (jointly owned by Air Reduction Company Inc. and The Ruberoid Company) at Calvert City, Kentucky.



Playing a major role in this record-setting performance are 14 Pfaudler Glasteel reactors. With good reason. Glasteel—glass inside, steel outside—is the ideal material for polymerization.

Its surface is corrosion resistant and exceptionally smooth, so PVC does not react with it or readily adhere. This keeps product losses down. It also means that complete cleaning is quick and sure. You can do it between batches with the Pfaudler glassed Spray Rinse valve.

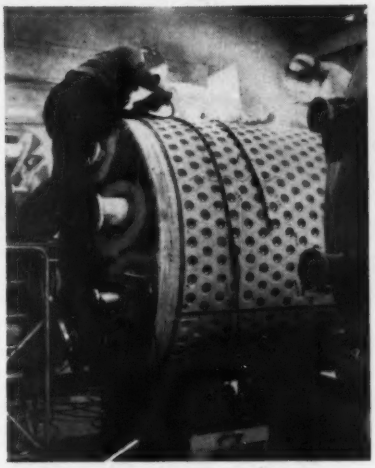
And, Glasteel will not contaminate or discolor any of the materials you use in making resins. Let us answer your questions in detail; ask for Bulletin 932.

Dimpled jacketed stainless reactors now rated at 180 psi

Dimpled jackets in themselves provide more effective heat transfer and higher pressures than heavier wall conventional jackets.

But, build them out of *Inconel* and you further extend design performance.

Now you can operate Pfaudler stainless steel reactors to 180 psi jacket pressure against full vacuum or a 75 psi internal. Inconel, as you would guess, is the jacket material.



Higher jacket pressure is one advantage, but an Inconel dimpled jacket offers these additional features:

1. Use any conventional jacket-heating medium including the chlorinated hydrocarbons and chloride brines.
2. Forget about surface corrosion on both inside and outside of the jacket.
3. Eliminate any concern you might have about stress-corrosion cracking.

Inconel dimpled jackets are standard on all Pfaudler stainless steel reactors of from 750 to 4,000 gallons. Complete specifications are included in our *new* Bulletin 1005. For your copy, write to the address listed below.

Address all inquiries to: Pfaudler Division, Dept. CW-91, Rochester 3, New York.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes

FLUIDICS* AT WORK

TITANIUM CHLORINE COOLER REQUIRES NO MAINTENANCE

If you talked with the people at Stauffer Chemical Company, Niagara Falls, N. Y., you'd find they are not concerned that this chlorine gas cooler is located in a relatively inaccessible spot.

In fact, you'd learn that they placed it here deliberately in order to save production space within their plant.

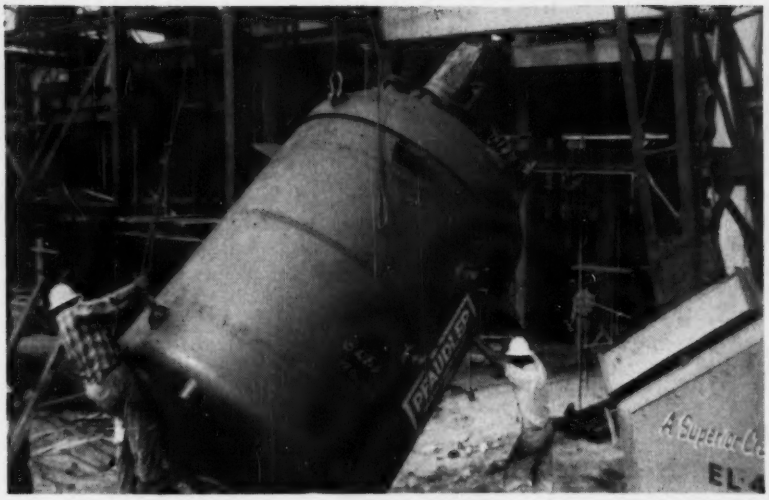
Why? It's made of titanium.

No down time. Installed in Cellhouse No. 1, where a heavy tonnage of chlorine is cooled daily, this 394 sq. ft. Pfaudler® heat exchanger cools chlorine gas from 75° to 40° C. Unlike the other coolers at Stauffer, this titanium unit has required *no* maintenance whatsoever since going into operation late in 1959.

Zero corrosion. This performance record is due to the fact that titanium is completely immune to corrosion by wet chlorine. Because of this, you can locate such coolers without regard to headroom. You don't have to worry about getting at them for inspection, cleaning, or other maintenance.

Sound investment. Moreover, the almost infinite service life of titanium in wet chlorine makes such a cooler an exceptionally sound investment. Compare titanium with other materials, taking into account length of service expected and maintenance required, and the economics of titanium will be apparent.

Availability. Along with titanium, Pfaudler also provides production-sized equipment made of tantalum and zirconium. For the full story, ask for Bulletin 978 —*Titanium, Tantalum and Zirconium Process Equipment by Pfaudler.* Address your inquiries to the address shown on the facing page.



On stream with Pfaudler

This could be your new plant. And one of the men at the site could be from our Field Service group.

His job? Supervising the installation of Pfaudler equipment. Giving expert attention to every detail during uncrating, rigging, erection and hook-up. Assuring operational efficiency.

Such responsibility is the task of our 15-man Field Service staff. The eldest in the group has been servicing Pfaudler equipment for 25 years. The rest? Varying amounts of time. All bring specialized knowledge and skills to the job; the kind that pay off handsomely for you.

These specialists now also offer complete *start-up service*. They check out the equipment, along with your piping—make sure you go on stream with complete confidence.

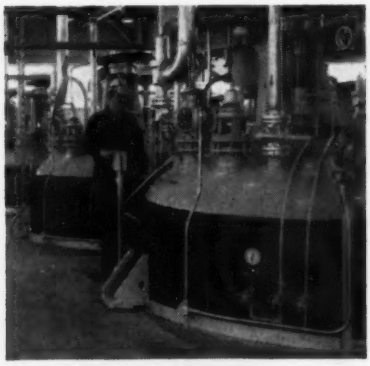
Emergency service is also part of our Field Servicemen's job. Like? When a fire damaged a customer's plant, a Pfaudler tank needed extensive repairs. Our men had the tank removed from the line, shipped it to our plant, and then reinstalled it—*all within a single week*.

These 15 men are strategically located throughout the country. Their services are literally as close to you as your phone.

For more details and cost information, call BEverly 5-1000 in Rochester, New York, and ask for CUSTOMER SERVICE. From then on, *your* problem is ours!

Glasteel helps set records with PVC

High yields, complete protection for product purity, and minimum down time is the story at Cumberland Chemical Corporation's plant (jointly owned by Air Reduction Company Inc. and The Ruberoid Company) at Calvert City, Kentucky.



Playing a major role in this record-setting performance are 14 Pfaudler Glasteel reactors. With good reason. Glasteel—glass inside, steel outside—is the ideal material for polymerization.

Its surface is corrosion resistant and exceptionally smooth, so PVC does not react with it or readily adhere. This keeps product losses down. It also means that complete cleaning is quick and sure. You can do it between batches with the Pfaudler glassed Spray Rinse valve.

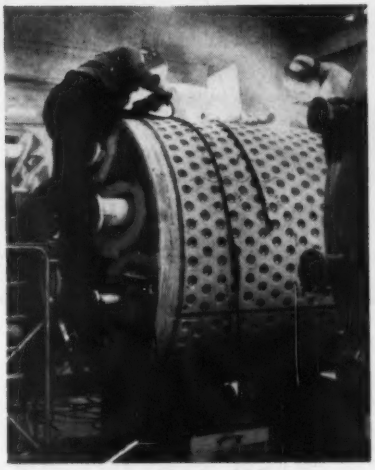
And, Glasteel will not contaminate or discolor any of the materials you use in making resins. Let us answer your questions in detail; ask for Bulletin 932.

Dimpled jacketed stainless reactors now rated at 180 psi

Dimpled jackets in themselves provide more effective heat transfer and higher pressures than heavier wall conventional jackets.

But, build them out of *Inconel* and you further extend design performance.

Now you can operate Pfaudler stainless steel reactors to 180 psi jacket pressure against full vacuum or a 75 psi internal. Inconel, as you would guess, is the jacket material.



Higher jacket pressure is one advantage, but an Inconel dimpled jacket offers these additional features:

1. Use any conventional jacket-heating medium including the chlorinated hydrocarbons and chloride brines.
2. Forget about surface corrosion on both inside and outside of the jacket.
3. Eliminate any concern you might have about stress-corrosion cracking.

Inconel dimpled jackets are standard on all Pfaudler stainless steel reactors of from 750 to 4,000 gallons. Complete specifications are included in our *new* Bulletin 1005. For your copy, write to the address listed below.

Address all inquiries to: Pfaudler Division, Dept. CW-91, Rochester 3, New York.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes

For the fourth time in five years, increased production has enabled Celanese

to reduce the price of TRIMETHYLOLPROPANE

Celanese trimethylolpropane—the ideal intermediate for producing urethane foams and coatings, and alkyd resins—is now available at the lowest price in its history: *30.5¢ per pound.* That means you can get all the many advantages of trimethylolpropane—and save money at the same time.

In urethane foams, trimethylolpropane offers three *primary* hydroxyls as the base for polyethers. This results in uniform products and assures reproducibility. It also means improved dimensional stability and heat distortion points in the finished foams. Used in urethane coatings, this intermediate improves heat, chemical and corrosion resistance.

Alkyd resins made with trimethylolpropane are characterized by impact resistance, hardness, flexibility, adhesion, and resistance to yellowing, heat and chemical attack.

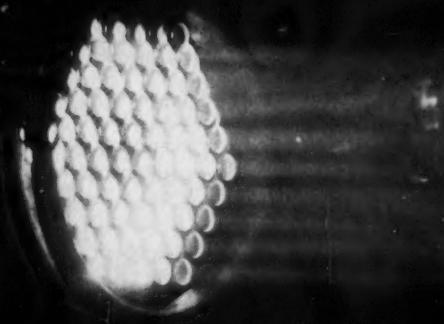
At the new low price, you simply can't afford *not* to investigate the advantages of trimethylolpropane in your application. For information, please write, briefly outlining the use you have in mind. Celanese Chemical Company, Dept. 552-S, 180 Madison Ave., N.Y. 16.

Celanese®

Celanese CHEMICALS

*Zone I Carload Price (per pound)
Zone II Price: 31.5¢ (Ariz., Calif., Idaho, Mont., Nev., Ore., Utah, Wash.)

Celanese Chemical Company is a Division of Celanese Corporation of America.
Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16.



This Electro-Optical Systems' cesium ion engine is operating in a vacuum simulating space.

New Push for Space Propulsion Systems

Besides stepping up research on solid fuels for space boosters (CW, Aug. 26, p.21), the chemical industries are now perking up to other space-race opportunities. Three news items relate CPI interests to the task of speeding rockets on outer-space missions:

(1) While electronics and aircraft firms are developing cesium ion engines, Chemalloy Minerals, Ltd. (Toronto, Ont.) is stepping up its cesium mining program and Dow Chemical (Midland, Mich.) joined the growing number of firms selling cesium.

(2) The American Rocket Society held a symposium last week at Northwestern University (Evanston, Ill.) to evalute current advances in magnetohydrodynamic (MHD) power and propulsion.

(3) The National Aeronautics and Space Administration (NASA) recently let a $6.3-million, six-month contract to Aerojet-General Corp. (Sacramento, Calif.) and Westinghouse Electric Corp. (Pittsburgh, Pa.) for first-phase development of the NERVA nuclear rocket engine.

The problem of sending spaceships on outer-space missions—beyond 1,000 miles from earth—is completely different from the problem space boosters tackle. Although these boosters can be used for lunar trips, they are built basically to overcome gravity. And gravity is not a problem in space.

Conventional liquid and solid propellants are fine for booster-type rockets. These propellants produce high thrust. But in outer space, only a small amount of thrust is needed to build up very high velocities.

To meet the needs of outer-space travel, three types of propulsion are being researched: (1) electrical systems, (2) nuclear systems, and (3) exotic chemical fuel systems.

Ion Propulsion: Within the field of electrical rocket engines, research contracts have been awarded for work on ion, arc-jet and MHD systems (*see Dimension, p. 108*).

Ion engines are closest to being operational. In early '62, the Scout engine is scheduled to carry a Hughes Aircraft ion rocket unit as part of the payload. That is, the Scout will be propelled by its own rocket, but the ion system will get flight testing.

The Hughes ion rocket plus at least two others will be flight tested in '62 and early '63—one by NASA's Lewis Research Center (Cleveland, O.) and one by Electro-Optical Systems, Inc. (Pasadena, Calif.). They will all use cesium as the ion source—approximately 20 lbs./rocket.

Predictions by Ernst Stuhlinger of NASA's Marshall Center (Huntsville, Ala.) are for rocket and research use of 4,000 lbs. of cesium in '63 and 1 million lbs. in '65 (*CW, Aug. 5, p. 116*).

Some industry sources have called these figures high. High or not, they do call attention to the growing market for cesium in ion propulsion. It could develop into big business. The price of the metal is now $325/lb. in small (5-9 lb.) lots.

Arc-Jet Studies: Plasmadyne, Inc. (Santa Ana, Calif.) will supply an arc-jet engine for a NASA flight test scheduled for early '63. This will be the first arc-jet test.

The heart of the exploratory research on arc-jets concerns the kinetics and thermodynamics of reactions run at very high temperatures. An arc-jet at Koppers Co. (Pittsburgh, Pa.) yields temperatures up to 25,000 F. And, although this is only in a space of about ⅛ in., larger jets could do the same job on a bigger scale.

The problems involved at temperatures five and six times ordinary combustion temperatures are still not fully defined. One difficulty is in "freezing" the reaction products, since equilibrium points are passed very quickly.

New methods of chemical synthesis

ESPECIALLY DEVELOPED and PROVED FOR USE IN SOLVENT RECOVERY

COLUMBIA
TRADE MARK

Activated Carbon

GRADE SXWC

"COLUMBIA" activated carbons are designed to provide a high-volume activity to insure top performance in all applications. Principal advantages include:

- High Adsorbent Capacity
- Long-life Hardness • Uniform Size
- High Porosity • Low Ash Content
- Repeated Recycling and Economical Reactivation

FREE SAMPLES

of grades for your process are available—with new application analysis sheet to expedite technical service. Consultation is free—*write us today!*

"Columbia" and "Union Carbide" are registered trade-marks for products of

NATIONAL CARBON COMPANY

Division of Union Carbide Corporation
270 Park Avenue • New York 17, N. Y.
In Canada:
Union Carbide Canada Limited, Toronto

UNION CARBIDE

Space-Ship Propulsion Systems

Type	*Firms With Key Research Contracts*	*Materials Used and Status*
Electrical		
Arc-Jet (electrothermal)	**Avco Corp. (Everett, Mass.)** **General Electric Co. (Philadelphia, Pa.)** **Plasmadyne Corp. (Santa Ana, Calif.)**	Uses hydrogen, helium or lithium vapor, possibly ammonia or hydrides. By '64 it could be used for lunar flights, orbital changes.
Magnetohydrodynamic (MHD) (electrodynamic or electromagnetic)	**Avco Corp.** **Convair Division of General Dynamics, Inc. (San Diego, Calif.)** **General Electric Co.** **Litton Industries, Inc. (Beverly Hills, Calif.)** **Republic Aviation Corp. (Farmingdale, N.Y.)**	Uses any ionizable material. Hydrogen, mercury and cesium gases are promising. Still in applied research.
Ion (electrostatic)	**Aerojet-General Corp. (Sacramento, Calif.)** **Convair Division** **Electro-Optical Systems, Inc. (Pasadena, Calif.)** **Goodrich-High Voltage Engineering Corp. (Burlington, Mass.)** **Hughes Aircraft Co. (Culver City, Calif.)** **Rocketdyne Division of North American Aviation (McGregor, Tex.)** **Thompson Ramo Wooldridge, Inc. (Cleveland, O.)** **United Aircraft Corp. (East Hartford, Conn.)**	Uses alkali metals, mostly cesium; also tungsten. First tests late this year or in '62.
Nuclear	**Aerojet-General Corp. Rocketdyne Division** **Westinghouse Electric Corp. (Pittsburgh, Pa.)**	Three main types: solid-core, liquid-core, gaseous-core. Hydrogen used and isotopes of cerium, polonium, thulium. Vehicle now being developed.

Note: Several universities and government agencies are prime researchers also. Related space studies are in progress at many other firms.

are a hoped-for bonus of plasma research. Just about any petrochemical process that requires high temperature might use plasma jets to achieve lower processing costs, easier operation and higher throughput.

And another field in which arc-jet research is expected to pay off is the reduction of precious metal ores.

Magnetohydrodynamics: MHD is still in the research stage. The first flight test is estimated to occur about '66, although an MHD rocket might fly as payload earlier.

But people like George Sutton at General Electric's Space Sciences Laboratory (Philadelphia) and Stewart Way of Westinghouse see a long road for MHD. However, Westinghouse has enough confidence in MHD to use private funds for researching it. And J. Sargent Janes of Avco corp. (Everett, Mass.), says, "MHD propulsion is now technically feasible, but basic research is necessary for an efficient system." These firms plus MHD Research, Inc. (Newport Beach, Calif.), are looking at MHD for central power stations as well as for propulsion.

Nuclear Propulsion: The recent con-

Nevillac® helps you control the flow of adhesive formulations

One of the advantages gained in the use of Nevillac, Neville Chemical Company's family of hydroxy resins, is greater control of viscosity in adhesives. Depending upon whether you use Nevillac Hard, Nevillac Soft or Nevillac 10°, you will be able to lower molten viscosity to any reasonable degree.

And there are several other good reasons for making Nevillac a part of your formulations. These resins possess a natural ability to bring unfriendly materials into compatible mix, since they are so highly compatible and soluble themselves. This applies to their use with most elastomers, plasticizers and other resins. Nevillac also improves surface adhesion, promotes quick initial grab, improves bond strength and adds resistance to water, acids and alkali. In addition, they possess generally good light stability, permanent thermoplasticity and ease of emulsion. If you formulate adhesives, it may pay you to investigate further.

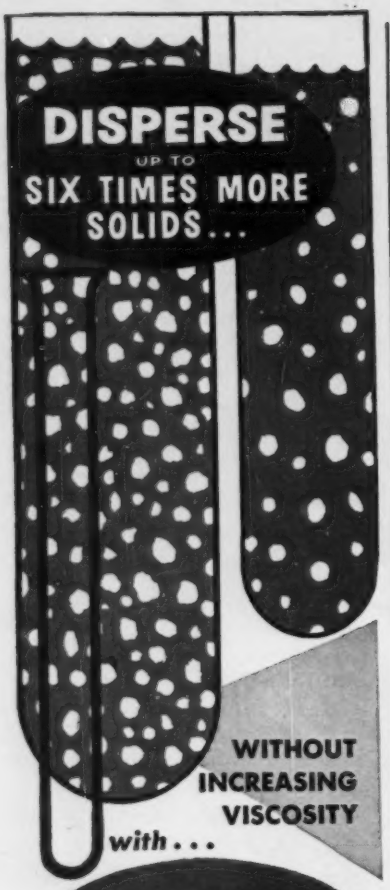
Write for Technical Service Bulletins No. 72 and 75.

Neville Chemical Company, Pittsburgh 25, Pa.

NEVILLE®

Neville Products

Resins—Coumarone-Indene, Hydrocarbon (Thermoplastic and Heat Reactive), Hydroxy • **Oils**—Plasticizing, Neutral, Rubber Reclaiming, Shingle Stain • **Solvents**—Aromatic (Refined and Crude), Semi-Aromatic (Refined and Crude). • **Antioxidants**—Non-Staining Rubber • **High Purity Indene • Indene Derivatives • Crude Naphthalene.**



MARASPERSE®
LOW COST, MORE EFFECTIVE
DISPERSANTS

The addition of only .05% to 3.0% of Marasperse disperses insoluble particles in water suspension and prevents agglomeration.

Viscous pasty masses become thin free-flowing fluids . . . Settling of suspended solids is prevented or greatly retarded . . . Slurries are kept fluid even with greatly increased concentration of solids.

Marasperse dispersants are non-hygroscopic, free-flowing powders.

Use the coupon below for additional information and samples.

MARATHON
A Division of American Can Company
CHEMICAL SALES DEPARTMENT
MENASHA, WISCONSIN

MARATHON
A Division of American Can Company
CHEMICAL SALES DEPT. • MENASHA, WIS.
Please send Information File No. W/- ☐
Samples ☐ of MARASPERSE for use in
_____
NAME_____
COMPANY_____
ADDRESS_____
_____

tract to Aerojet and Westinghouse comes as the outgrowth of work done at the Los Alamos Atomics Laboratory (Los Alamos, N.M.). Los Alamos is continuing its basic and applied studies on nuclear engines and rockets.

These rockets might handle both the job of taking off from earth and traveling in deep space. They will not be tested until '66 or '67. But of NASA's requested research appropriations for fiscal '62, about $40 million (out of $1.3 billion) is for nuclear systems research—vs. about $7 million for electrical propulsion.

Milton Klein, deputy manager of NASA's Nuclear Propulsion Office, expects nuclear research to grow substantially. Now, the work is directed to solid-core engines. And the highest

DIMENSION

How the Space Propulsion Systems Work

The three major types of electrical systems—arc-jet, MHD and ion—involve plasmas. (A plasma is an ionized fluid where the negative and positive charges are equal.)

Arc-jet systems work by using electrical energy to heat a gas. The plasma that forms in the hot gas is only a characteristic of the system, not its basis. Air, hydrogen, helium or another gaseous chemical fuel is put between two electrodes. An arc is struck between the electrodes. The gas, which immediately gets very hot but not evenly so, is let into a chamber where the heat distributes itself. Then the gas is squirted out a nozzle causing motion.

There is a limit on the upper temperature of the gas. This so-called "frozen-flow" limit is the point where interaction between the molecules makes it inefficient to raise the temperature any higher. Such systems thus find relatively low specific impulse applications (up to 3000-4000-lb.-sec./lb.). (Specific impulse is the pounds-force of thrust developed per mass of propellant used per second.)

MHD units actually utilize a plasma in their operation. Electrical energy forms a plasma out of a gas; then it is accelerated by a magnetic field.

With this scheme, the problem of frozen flow is eliminated and much higher temperatures can be reached. A popular misunderstanding is the specific impulse limit that MHD systems can reach. Originally, MHD was aimed at jobs requiring specific impulses above the limit of arc-jet engines but below that of ion engines. Now it has been shown that MHD can produce impulse well above 5,000 lb.-sec./lb.

Ion engines work on the principle that like charges repel each other. A plasma forms outside the engine itself; so again, the plasma is not the basis of operation.

In this system, a fuel is heated to its vaporizing temperature. To date, this fuel has most often been cesium because it forms a heavy ion and thus requires a smaller, lighter engine.

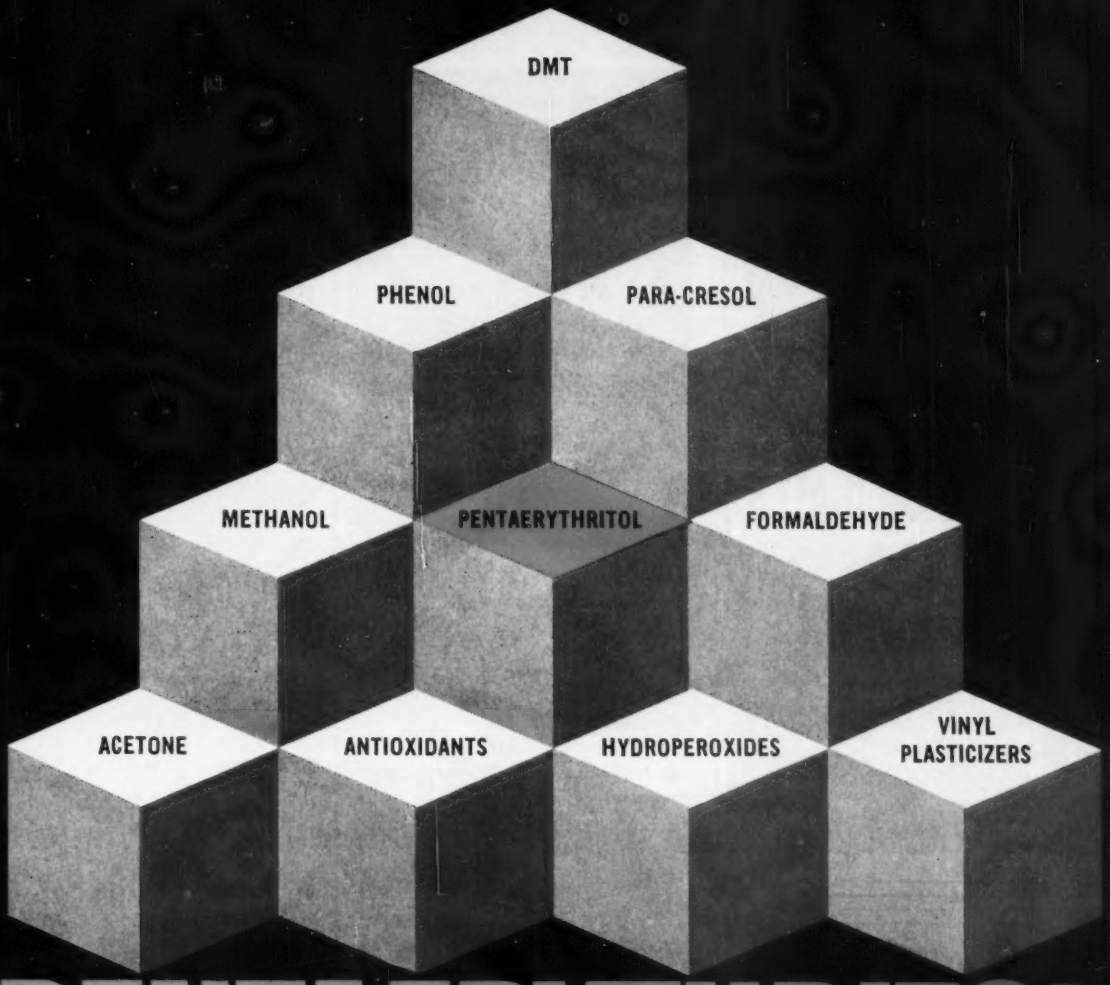
As the cesium is vaporized, it passes through porous tungsten. The tungsten strips electrons from the cesium atoms, leaving a relatively slow-moving positive cesium ion. An electrostatic field accelerates the ions.

But they are not shot directly out of the engine. Instead the ions are decelerated, focused into a beam and electronically neutralized to form the plasma before exhausting. Without this neutralization step, negative charges would build up on the space vehicle itself and would slow down a positively charged exhaust.

Nuclear-powered rockets involve heating a propellant with a nuclear reactor and ejecting the hot material through a nozzle. In a solid-core reactor, the reactor has fuel elements which consist of fissioning uranium-235 protected by solid materials with very high melting points. The propellant, which most often has been hydrogen, flows over the uranium and is heated to as high as 6000 F.

In a liquid-core reactor, the hydrogen is bubbled right through liquid uranium. This interaction makes possible temperatures as high as 7000 F.

When the uranium fuel is held in the gaseous state, it is estimated that 30,000 F is possible. But with such a high temperature, there are more problems than that of container stability. The density of the uranium must be high enough to keep the chain reaction going and the purity of the gas must be very high.



PENTAERYTHRITOL

HERCULES IS A PREFERRED SOURCE OF ORGANIC CHEMICALS

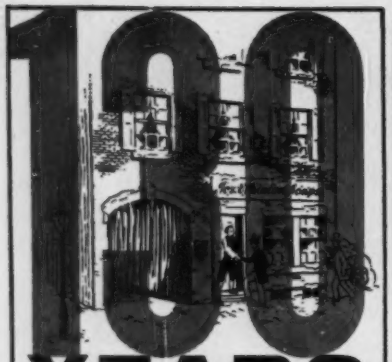
Three factors have made Hercules a preferred source of pentaerythritol (PE).

* * * A dependable supply from an integrated plant where rigid control of raw materials as well as finished product is maintained.
* * * Quality, based on years of production experience, that has set an industry standard.
* * * Application know-how that makes your research dollars go further.

For complete details about PE and the other "building blocks" listed above, get in touch with us.

HERCULES POWDER COMPANY
INCORPORATED

Synthetics Department, Hercules Tower, 910 Market Street, Wilmington 99, Delaware



100 YEARS
IN CHEMICAL SERVICE
SOAP TO SILICATES

Soaps and candles were our first products in 1831. Twenty-five years later we began to make sodium silicate. Since 1904 we have specialized in silicates.

From the original use in household soaps, through research, silicates have been applied in many industrial processes . . .

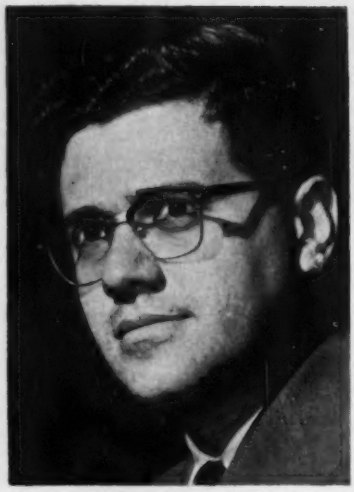
Adhesives • cements • detergents • reactants • deflocculants dispersants • base for sols and gels coatings and films.

For literature or information call MArket 7-7200 (area code 215) or write us.

PHILADELPHIA QUARTZ CO.
1150 Public Ledger Bldg., Phila. 6, Pa.
manufacturers of
SOLUBLE SILICATES
100TH ANNIVERSARY 1831-1961
TRADEMARKS REG. U. S. PAT. OFF.

Associates: *Philadelphia Quartz Co. of California Berkeley & Los Angeles, California; Tacoma, Wash. National Silicates Limited, Toronto & Valleyfield, Canada.*

PQ PLANTS: ANDERSON, IND.; BALTIMORE, MD.; BUFFALO, N.Y.; CHESTER, PA.; JEFFERSONVILLE, IND.; KANSAS CITY, KANSAS; RAHWAY, N.J.; ST. LOUIS, MO.; UTICA, ILL.



G. W. Sutton of GE's Space Sciences Laboratory sees a long road for MHD.

hurdle to overcome is the development of materials that will withstand high temperatures.

The chemical industries will join nuclear rocket research in materials development, besides such fields as radioactivity and chemical refinement of spent reactor elements. Fusion reactors tie in with MHD; so studies on plasmas may link with nuclear reactor work.

Exotic Chemicals: Bell Aircraft Corp. (Buffalo, N.Y.) is now testing a pair of advanced chemical propellants developed by Allied Chemical Corp. (New York). Slated strictly for deep-space vehicles, the two propel-

G. Sargent Janes, an Avco MHD expert, cites need for basic research.

Better and more profitable pesticides through

RESEARCH

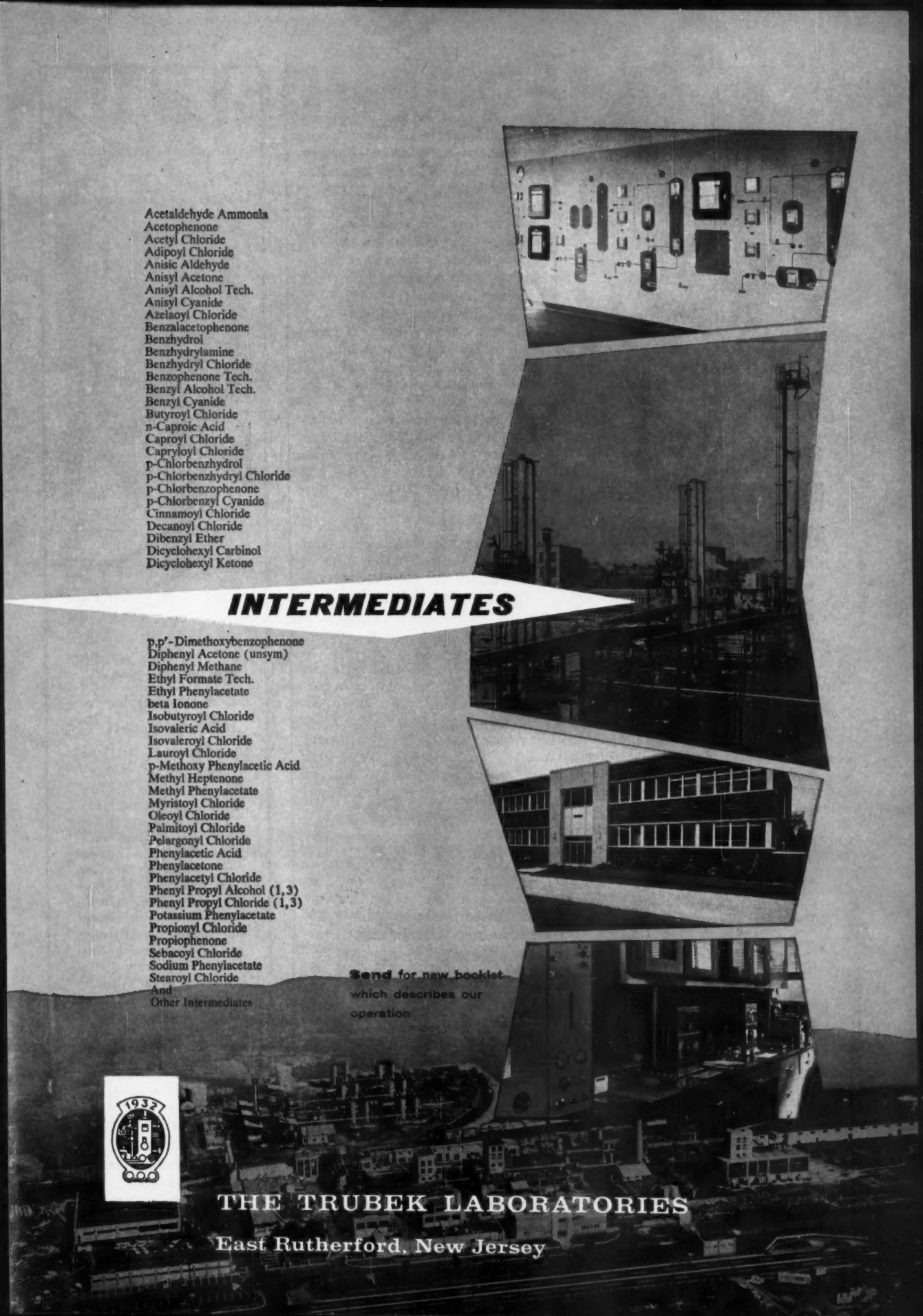
Screen your promising chemical compounds for potential activity and commercial use as . . .

- INSECTICIDES
- HERBICIDES
- NEMATOCIDES
- SLIMICIDES
- ALGAECIDES
- BACTERICIDES
- FUNGICIDES

Send for complete details on procedures and prices.

P. O. Box 2217
Madison 5, Wisconsin

WISCONSIN ALUMNI RESEARCH FOUNDATION


Acetaldehyde Ammonia
Acetophenone
Acetyl Chloride
Adipoyl Chloride
Anisic Aldehyde
Anisyl Acetone
Anisyl Alcohol Tech.
Anisyl Cyanide
Azelaoyl Chloride
Benzalacetophenone
Benzhydrol
Benzhydrylamine
Benzhydryl Chloride
Benzophenone Tech.
Benzyl Alcohol Tech.
Benzyl Cyanide
Butyroyl Chloride
n-Caproic Acid
Caproyl Chloride
Capryloyl Chloride
p-Chlorbenzhydrol
p-Chlorbenzhydryl Chloride
p-Chlorbenzophenone
p-Chlorbenzyl Cyanide
Cinnamoyl Chloride
Decanoyl Chloride
Dibenzyl Ether
Dicyclohexyl Carbinol
Dicyclohexyl Ketone
INTERMEDIATES
p,p'-Dimethoxybenzophenone
Diphenyl Acetone (unsym)
Diphenyl Methane
Ethyl Formate Tech.
Ethyl Phenylacetate
beta Ionone
Isobutyroyl Chloride
Isovaleric Acid
Isovaleroyl Chloride
Lauroyl Chloride
p-Methoxy Phenylacetic Acid
Methyl Heptenone
Methyl Phenylacetate
Myristoyl Chloride
Oleoyl Chloride
Palmitoyl Chloride
Pelargonyl Chloride
Phenylacetic Acid
Phenylacetone
Phenylacetyl Chloride
Phenyl Propyl Alcohol (1,3)
Phenyl Propyl Chloride (1,3)
Potassium Phenylacetate
Propionyl Chloride
Propiophenone
Sebacoyl Chloride
Sodium Phenylacetate
Stearoyl Chloride
And
Other Intermediates
Send for new booklet which describes our operation
1932
THE TRUBEK LABORATORIES
East Rutherford, New Jersey

IS YOUR TARGET

the profitable household specialties market?

Formulating problems are simplified, and consumer acceptance increased when VEEGUM® is included in chemical specialties formulas.

Waxes, polishes, cleansers, detergents and a host of related products are now more effective because of VEEGUM. This is true in Automotive specialties, as well as Household products.

Water dispersions of VEEGUM suspend, thicken and stabilize. VEEGUM is thixotropic. It is non-toxic, non-irritating, white and opaque.

VEEGUM is colloidal magnesium aluminum silicate, refined and purified.

Write for formulas and technical data today.

Want a quick reference to a complete listing of all Specialties Department formulas? Send for our FORMULA FINDER.

R. T. VANDERBILT CO.,
SPECIALTIES DEPARTMENT
230 PARK AVENUE
NEW YORK 17, N. Y.

Please send:
( ) Bulletin 20C — Automotive Formulas
( ) Bulletin 30C — Household Formulas
( ) The Formula Finder
( ) Sample of VEEGUM

State Application .....

Name .....

Title .....

(Attach to your Company letterhead) P-21

lants are liquid fluorine in combination with hydrogen and liquid fluorine combined with hydrazine. However, one drawback of the hydrogen-fluorine fuel is the toxic cloud of vapor it gives off.

Rocketdyne (McGregor, Tex.), a division of North American Aviation Inc., is looking at ammonium nitrate oxidizer and butadiene methylvinylpyridine fuel-binder (*CW, Jan. 14, p. 34*) and similar combinations.

Thiokol Chemical Corp. (Trenton, N.J.) is seeking out metal hydrides. Hybrid systems of liquids and solids extend the density impulse beyond fluorine-hydrazine so they may get called for rockets with volume as well as weight limitations. But the fluorine-hydrazine hookup still has the attraction of high specific impulse and self-ignition besides relatively high density.

Forecast: The CPI has steeped itself in the space business for several years. And now the thought of getting rockets to other planets is not a distant dream. It may well be a reality of this decade.

Photon rockets and solar sails may be dreams. But Congress' total allocation of $1.7 billion to NASA this fiscal year is reality. And one-quarter of this will be used to develop chemically fueled rockets. Some of the electrical and nuclear systems will also use these fuels. Other fuels will power conventional rockets. Outer space is the not-too-distant target of this research.

LITERATURE

• "Patents for Management," described as a "patent and antitrust guide for busy executives", is newly available from Advance House, Publishers (P.O. Box 334, Ardmore, Pa.) for $5.50. Author is Worth Wade, who has also written "Patents for Technical Personnel."

• The American Council of Independent Laboratories, Inc. (4302 East-West Highway, Washington 14, D.C.), has issued the 8th edition of its membership directory. It's available, without charge, to industrial and government executives when requested on company or official letterhead.

• "Fundamentals of Solid Rocket Propulsion" is available from OTS, U.S. Dept. of Commerce, Washington.

Sometimes it's better to let Eastman make it

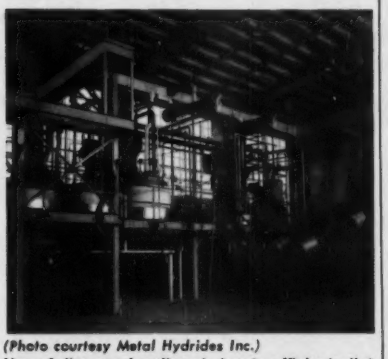
Got a production problem? Does it involve the manufacture of a compound that's not generally available in the quantity or purity you require? Then consider this. We are equipped for and experienced in synthesis on a custom basis for quantities in the larger-than-laboratory-but-less-than-tankcar range. For information about this service, or a quotation, write *Distillation Products Industries,* Eastman Organic Chemicals Department, Rochester 3, N. Y.

DPi

DISTILLATION PRODUCTS INDUSTRIES
is a division of
EASTMAN KODAK COMPANY

U.S.I. CHEMICAL NEWS

September | A Series of Advertisements for the Chemical Process Industries | 1961



(Photo courtesy Metal Hydrides Inc.)
Use of dispersed sodium is key to efficient pilot and plant scale production of sodium borohydride. First step, shown here, is to make sodium hydride by reacting hydrogen gas with metallic sodium dispersed in mineral oil. The sodium hydride is later reacted with methyl borate to produce sodium borohydride. Further information on sodium dispersions is contained in U.S.I.'s 42-page brochure on the subject. For a copy, address Technical Literature Dept., U.S.I. Chemical News, 99 Park Avenue, New York 16, N. Y.

New Brochure Covers Bulk Storage of S. D. Alcohols And Proprietary Solvents

Users of specially denatured alcohol or proprietary solvents who are planning to install bulk storage tanks can get expert help from U.S.I.—America's oldest and largest marketer of industrial alcohol. The company has recently issued an 8-page data sheet: "Bulk Storage Tanks for Specially Denatured Alcohol and Proprietary Solvents."

It lists four prerequisites for installing bulk storage facilities, reviews federal regulations, discusses tank design—covering materials of construction, size and location. Two final sections provide information on auxiliary equipment and measuring devices.

(Continued on next page)

Amino Acid Intake-Protein Efficiency Relation Is Basis of New Diet Concept

Industry researchers have determined that the daily intake of essential amino acids should be proportional to the amount found in blood plasma. They find a direct correlation between dietary intake of these amino acids, their concentration in fasting blood plasma and protein efficiency.

Based on these findings, they have helped National Institutes of Health develop a diet concept which they feel will put nutritional studies on a sounder theoretical basis.

Ethylene Seen as Most Valuable Petrochemical Building Block By Chemical Process Industries

Properties and Reactions Detailed in New Brochure

Over five billion pounds of ethylene were produced and used in the United States last year. No other petrochemical, with the exception of synthetic ammonia (largely used for fertilizer), approaches this versatile material in volume consumed annually. Almost all of this volume is employed in the synthesis of chemical intermediates, or commercial chemicals such as alcohol and polyethylene. A small amount is used directly—as a refrigerant; as a softening, ripening and coloring agent for fruits and vegetables; and as a conditioning agent for nuts.

Ethylene in cylinders is sold by U.S.I. for food processing, as a refrigerant, and as a chemical raw material.

The values of ethylene to the CPI are its low cost and its ability to polymerize or react by addition with simple, inexpensive materials such as hydrochloric acid, oxygen and chlorine—to yield extremely useful intermediates or end products.

End Products Extremely Numerous

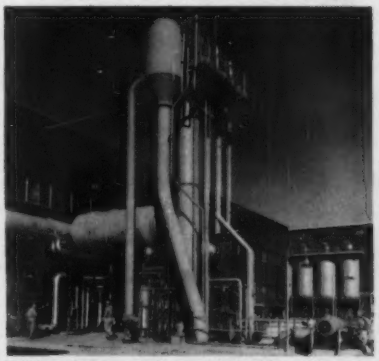
The largest quantity of ethylene produced is consumed by the chemical industry in the manufacture of six derivatives:
(1) Ethylene Oxide
(2) Polyethylene
(3) Ethyl Alcohol
(4) Styrene
(5) Ethyl Chloride
(6) Ethylene Dichloride
Ethyl ether is produced concurrently with ethyl alcohol.

End products from these derivatives are very numerous, and extremely important in our chemical economy. Ethylene oxide, for example, is the starting point for monoethylene glycol, used primarily in automotive antifreeze. It is also the building block for di- and triethylene glycols, ethanolamines, glycolethers, acrylonitrile, surfactants and other compounds.

Polyethylene is the fastest growing plastic on the market today. Consumption of ethylene for polyethylene in the U.S., totalling six million pounds in 1945, is expected to reaeh 1.6 billion by 1965.

Over 50% of all ethyl alcohol is con-

(Continued on next page)



U.S.I. ethylene unit supplies 100-million lb.-per-year polyethylene plant at Tuscola, Ill.

National Distillers, Owens-Illinois Form Co. to Make High-Density Polyethylene

Formation of a new, jointly owned company to make high-density (linear) polyethylene was announced recently by National Distillers and Owens-Illinois Glass Company. The name of the new company is National Petro Chemicals Corporation.

The new company will operate a plant in Houston, Texas, plans for which were announced by National Distillers last February. The plant, scheduled for completion in late 1962, will have an annual capacity of about 60 million pounds.

U.S.I. Division of National Distillers produces low and medium density polyethylene resins at plants in Houston, Texas and Tuscola, Illinois.

Ethylene—Valuable Building Block *(Continued)*

verted to acetaldehyde which in turn is the building block for countless derivatives. These include acetic acid and its anhydride, the acetates, n-butyraldehyde, n-butanol and pentaerythritol.

The need for styrene for butadiene-styrene synthetic rubber during World War II first brought ethylene to the fore as a chemical raw material. Today, styrene is the base material for polystyrene plastics and latex paints as well.

Ethyl chloride yields tetraethyl lead and ethyl cellulose. Ethylene dichloride gives rise to ethylene amines and to a large part of the vinyl chloride produced.

New Ethylene Literature Available

The demand for ethylene is expected to reach about 6.8 billion pounds by 1965. To help those working with the material, U.S.I. has just issued a new, comprehensive brochure covering refined ethylene. It contains tables and charts of physical properties, a two-page table of refrigeration data, specifications, shipping information, applications, diagrammed chemical reactions, complete cylinder handling information and bibliography.

Copies may be obtained by addressing Technical Literature Dept., U.S.I. Chemical News, 99 Park Ave., New York 16, N. Y.

U.S.I. Products Make News

On these pages are news stories on ethylene, polyethylene, sodium, ethyl alcohol and proprietary solvents, all products of U.S.I. But the company also markets other chemicals which seldom make news. We'd like to list them here:

n-Butyl alcohol, amyl alcohol, ethyl acetate, n-butyl acetate, acetone, ethyl ether.

Anhydrous ammonia, ammonium nitrate, nitric acid, nitrogen fertilizer solutions, phosphoric acid, sulfuric acid, sodium peroxide.

90-Gallon, Blow-Molded Polyethylene Drum Liners Produced by New Machine

Blow-molded polyethylene drum liners of 55- to 90-gallon capacity can now be obtained, thanks to the development of a new, giant blow-molding machine. It is felt that, in the near future, the adaptation of even larger molds to this new equipment will make possible successful production of up to 250-gallon containers.

U.S.I.'s PETROTHENE® 106 polyethylene resin has been molded into 55-gallon drum liners on this new equipment.

Bulk Storage of Alcohols *(Continued)*

Included are diagrams of typical above-ground and underground storage tanks. Other diagrams show details for gauging wells and for anchoring underground tanks.

For copies of the new bulk storage bulletin, write Technical Literature Dept., U.S.I. Chemical News, 99 Park Ave., New York 16, N. Y.

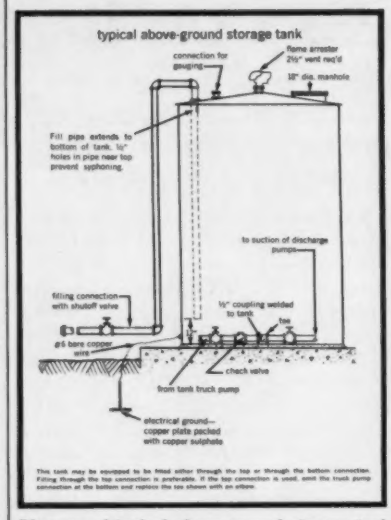

typical above-ground storage tank
connection for gauging
flame arrester
2½" vent req'd
18" dia. manhole
Fill pipe extends to bottom of tank. ½" holes in pipe near top prevent syphoning
to suction of discharge pumps
fitting connection with shutoff valve
½" coupling welded to tank
tee
#6 bare copper wire
check valve
from tank truck pump
electrical ground—copper plate packed with copper sulphate
This tank may be equipped to be filled either through the top or through the bottom connection. Filling through the top connection is preferable. If the top connection is used, omit the truck pump connection at the bottom and replace the tee shown with an elbow.

Diagram of typical above ground storage tank is included in U.S.I.'s latest Technical Data Bulletin, "Bulk Storage Tanks for Specially Denatured Alcohol and Proprietary Solvents."

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Low temperature properties of copper and its alloys is subject of literature now offered. For use in cryogenic equipment, copper said to provide remarkable retention of ductility at low temperatures. **No. 1750**

Aleuritic acid (9, 10, 16-trihydroxypalmitic acid) now available in commercial quantities. Suggested for use in perfumery (civetone, dihydrocivetone, epi-ambrettolide), pharmaceuticals, plasticizers, plastics, adhesives, etc. **No. 1751**

New filter holders, for use with submicron membrane filters in processing liquids, can now be obtained. Typical uses include contamination analysis, bacteria detection, drug sterilization, production of super-pure water. **No. 1752**

Protective coating formulations, based on distilled tall oil and tall oil fatty acids, are described in a new series of data sheets just issued. Give procedures for formulating, compositions, properties, suggested uses for each. **No. 1753**

Five new 5'-ribonucleoside di- and triphosphates, for large-scale experiments in nucleic acid chemistry and synthesis, have been developed. Include cytidine compounds CDP and CTP; uridine compounds UDP, UTP and UDP Glucose. **No. 1754**

Infrared physics is subject of new journal now published quarterly from London. Covers IR theory, experiment, instrumentation as applied to IR detection and transmission, and research problems using infrared. **No. 1755**

New volumetric concentrates, for rapid preparation of standard solutions claimed accurate to 0.1%, have been introduced. Come in spill-proof ampoules said to have long shelf-life. 38 Concentrates now offered. **No. 1756**

Toluene, benzene and xylene specifications for maximum acceptable concentrations in all places of employment are provided in three newly revised ASA standards now being sold. **No. 1757**

Scientific and Technical Societies of U.S. and Canada, 7th edition, can now be purchased. This standard reference book lists 1,597 U.S. and 239 Canadian societies, both national and local, with complete details. **No. 1758**

Chlorine properties are detailed in 28-page booklet now available. Booklet includes information on shipping, handling, safety measures, uses. Illustrated with graphs, charts, photos, drawings. **No. 1759**

Please use number when writing.

U.S.I.

U.S. INDUSTRIAL CHEMICALS CO.

Division of National Distillers and Chemical Corporation

99 PARK AVENUE • NEW YORK 16, N. Y.

PRODUCERS OF:

Industrial Alcohols, Solvents, Polyethylene Resins, Heavy Chemicals, Metallic Sodium

U.S.I. SALES OFFICES:

Atlanta • Baltimore • Boston • Chicago • Cincinnati Cleveland • Detroit • Kansas City, Mo. • Los Angeles Louisville • Minneapolis • New Orleans • New York Philadelphia • St. Louis • San Francisco

Dallas' rising skyline is symbolic of growing importance of this city in the Southwest.

Dallas—More CPI on its Skyline?

Two events of last month may soon materially affect the complexion of the chemical process industries in Dallas, Tex.

(1) A bill (HR 8467) was introduced in Congress that would provide appropriations to make about 400 miles of the Trinity River barge-navigable—this would give Dallas water transport to the Gulf and the Intracoastal Waterway.

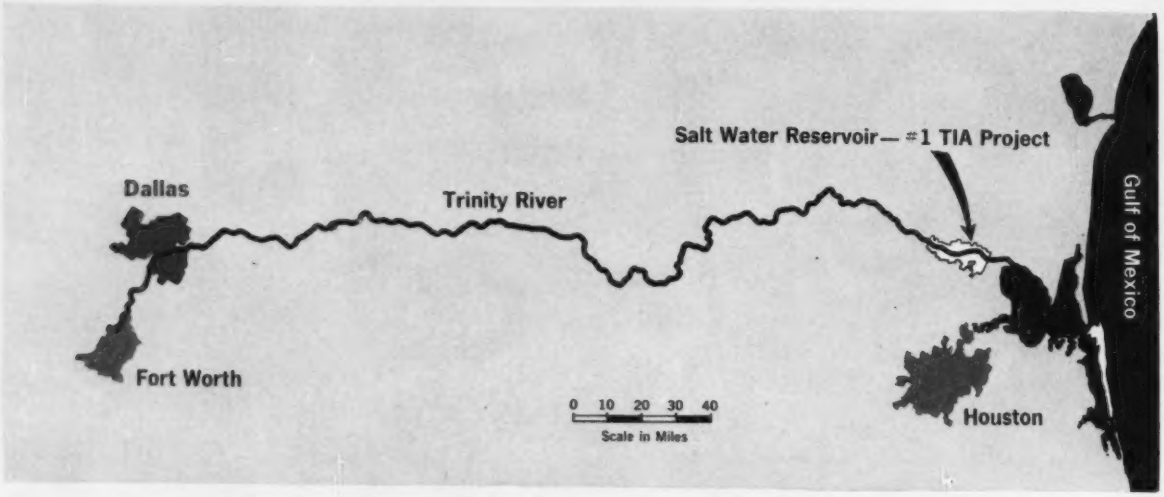
(2) The Graduate Research Center of the Southwest took steps to acquire a 2,000-acre headquarters site near Dallas—a move that could give the Southwest much-needed depth in chemical research. Both proposals are clearly aimed at bolstering the city's chemical strength.

Specialties makers now contribute most of the Dallas CPI output. Building programs in the Dallas area reflect this emphasis:

- A 200,000-gal./month paint plant costing $2 million has just been completed by Glidden Co. north of Dallas on a 34-acre site. The plant is built on a hillside, so that the flow from beginning to outlet of the plant is by gravity, downhill to the loading platforms.
- U.S. Gypsum has recently completed a paint plant in Dallas to serve a seven-state territory.
- Drackett Co. just started building a plant west of Dallas to manufacture its specialty chemical products, Windex and Drano.
- Later this year, National Cylinder Gas Division of Chemetron Corp. will complete a new air-separation plant to produce up to 120 tons/day of nitrogen, argon and oxygen. The plant will cost over $1 million and is being built adjacent to Texas Instruments' plant north of Dallas. It will supply rarefied gases to the electronics and aircraft industries in the Dallas area, and will pipe gases to Texas Instruments.

Products Pattern: The '58 census of manufactures lists 127 firms in Dallas manufacturing chemicals and allied products. Total employees: more than 3,100. Total annual value added by manufacture: more than $63 million. The comparable data for '47 are

By 1970 Dallas may have access to the sea via barge-navigable Trinity River.



75; over 2,100; and $25 million.

As might be guessed from the expansion projects, major products (in order of number of producers) are paints and varnishes, specialty chemicals and soap and detergents. Largest CPI plant is Procter and Gamble's detergent and soap operation, with about 700 employees. Two other plants located in Dallas primarily to serve as suppliers to Procter and Gamble are Hooker Chemical Co. with a phosphates chemical plant and Diamond Alkali with a sodium silicates plant. These chemicals are sold to detergent and cleaning compounders.

Typical CPI manufacturers with over 100 employees in the Dallas metropolitan area are Desoto Chemical Coatings, Inc., National Chemsearch Corp., Economics Laboratory, Inc., Sherwin-Williams Co., Armour Agricultural Chemical Co., Certain-Teed Products Corp., Ruberoid Co., Pioneer Hydrotex Industries, Inc. and Jones-Blair Paint Co. Great Western Producers, Inc., operates a small aromatics separation plant west of Dallas.

Dallas serves a primary market consisting of Texas, Oklahoma, Arkansas, Louisiana, and New Mexico; and a secondary area including Tennessee, Mississippi, Alabama, Missouri, Kansas and Colorado.

There were 118 wholesale establishments listed in the '58 census, selling chemicals, drugs and allied products, doing an annual business of $247 million. Among CPI companies having Dallas sales offices are Dow, Diamond Alkali, Hooker, Rohm & Haas, Union Carbide, Shell Chemical and McKesson and Robbins.

Financial Strength: Dallas ranks ninth among U.S. cities with respect to numbers of companies having at least $1 million in assets. Headquartered in Dallas are 373 "million dollar" companies. Dallas ranked 14th in the U.S. in population (689,000) in '60.

The city boasts more manufacturing employees than Houston—96,000 vs. 92,000. In value added by manufacture, however, Dallas lags behind Houston ($845 million annually vs. $1.2 billion) because of the higher value per employee of the refining and petrochemical industries at Houston.

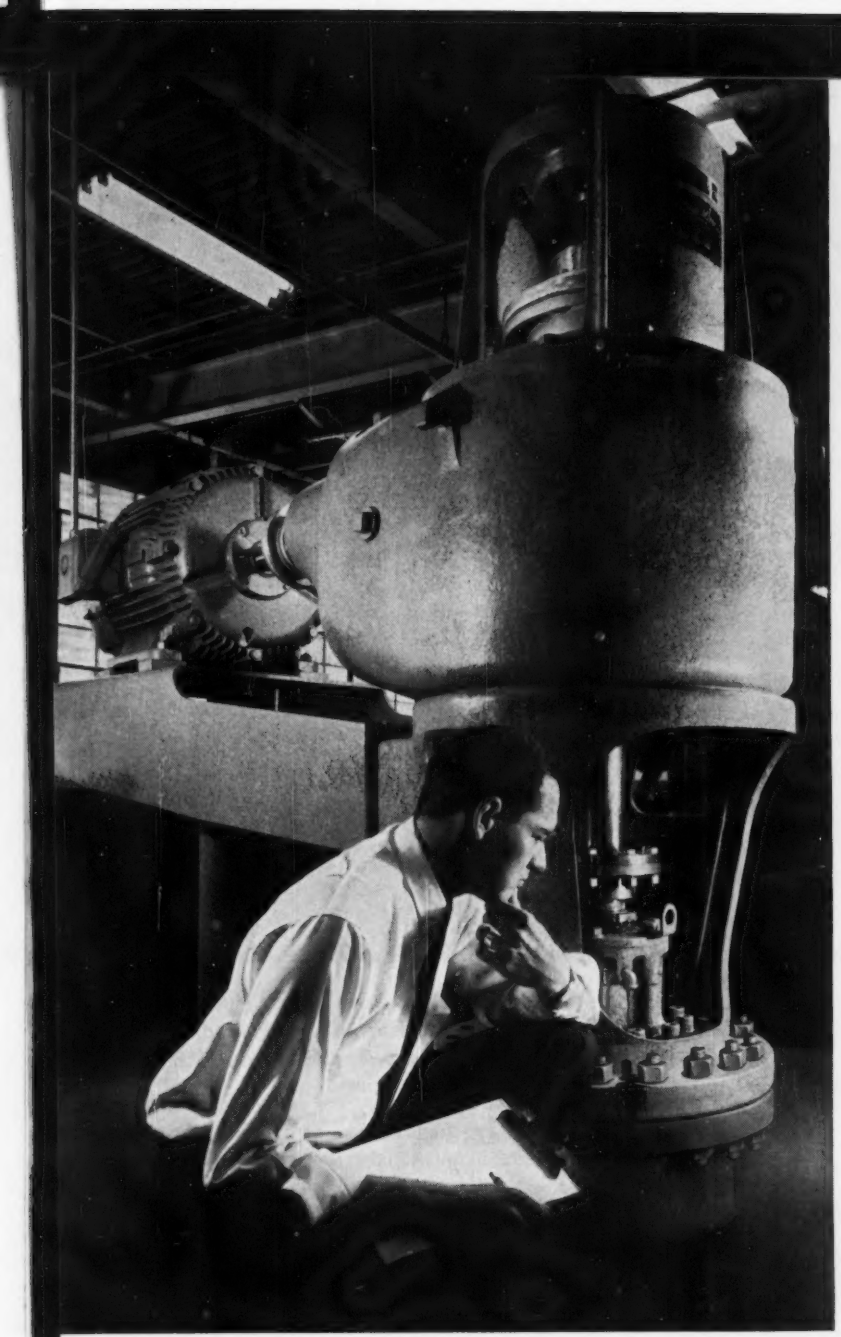
Heavier on Research: The purpose of the new GRC research center, (Proposals now include a site north of Dallas, near the small community of Renner.), according to its president, Lloyd V. Berkner, is to "act as a focal point around which simultaneous measures can be initiated voluntarily toward the creation of a significant and distinguished graduate academic program in the region." His aim: to help produce about 2,000 annual doctoral graduates (vs. 400 at present) in the Southwest in all fields of learning within the next 15 years. Armed with an initial endowment of $20 million, Berkner is planning to provide research facilities for both academic and industrial scientists drawn from Texas, Oklahoma, Louisiana, Arkansas, New Mexico and Arizona. And he will encourage companies to establish research labs at the immediate perimeters of the center.

Research at Chance-Vought, now part of Ling-Temco-Vought, may prove valuable to the CPI. Project Artesia, sponsored by the Office of Saline Water, is directed at developing a means for the solid fixation of radioactive wastes through calcination.

Such wastes are now stored in huge tanks in liquid form. After a solid is produced, Chance-Vought engineers propose to make it into pellets which can serve as an energy source for saline water conversion processes and heating systems. They propose to heat sea water directly by passing it through a bed of such pellets, and to recover fresh water by any of the processes that prove practical. A 250-gal./day pilot plant is now being built at Dallas for trial runs (it is to be shipped to Oak Ridge in '62 for testing with radioisotopes). Estimated water cost in a plant of 1-million gal./day is 80-90¢/1,000 gal.

Another project, Nuclide Heat, is sponsored by the Navy's Bureau of Yards and Docks. It calls for the development of systems to provide heating with radionuclides in remote or isolated installations, such as the U.S. outpost in Antartica.

Attention Getters: To attract more industry to Dallas, 20 planned industrial districts have been set up. The two areas with greatest growth poten-



SEAL'S LEAKING!

How much will the downtime cost?

Even the best-running shaft seal on a mechanical mixer is going to wear out some day.

What you pay for the shutdown depends on how fast you can get back into production.

This is a good point to settle *before* you choose the mixer. The right answer can save you as much as *$1,000 per seal change.* (Based on conservative estimates of downtime production losses, plus direct labor cost. We've seen savings go much, much higher.)

The close-up below shows why you're ahead with a LIGHTNIN Mixer, equipped with a LIGHTNIN Rotary Mechanical Seal. Notice this patented seal is an integral cartridge unit. It saves buying separate seal parts and wondering if they'll work when you put them together.

The LIGHTNIN Seal needs no special skill to replace. It bolts in place without dismantling the mixer, without entering the tank. Aligns itself automatically. Doesn't have to be checked. You *know* it's going to work. (We never ship a seal until we've tested it statically and dynamically at rated pressure.) Gets you back onstream fast—without trouble, without tricky adjustments.

If you'd like to look further into the dollars and sense of pressure-vessel mixing with seal-equipped LIGHTNIN Mixers, your LIGHTNIN man has some interesting figures to show you. You'll find his name in Chemical Engineering Catalog and in the yellow pages of your telephone directory. Call him today. Or write directly to us.

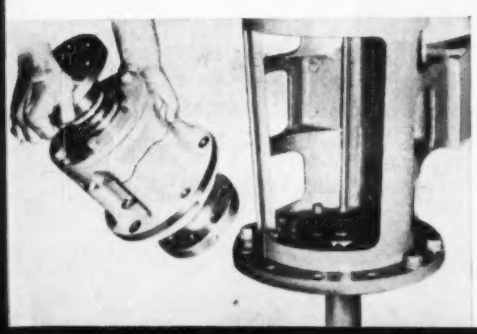
BEWARE OF "HIDDEN" MIXING COSTS

When choosing a mixer, ask yourself these six questions. Even one "yes" answer means you'll pay a needlessly high price—in lost production and in labor—to mix fluids.

To change or replace a shaft seal, will you have to:

	YES	NO
1. Check the new seal and sleeve for leaks?	☐	☐
2. Dismantle mixer or remove it from vessel?	☐	☐
3. Use skilled manpower to replace seal part by part?	☐	☐
4. Purge vessel in order to block up mixer shaft?	☐	☐
5. Uncouple mixer shaft *inside* the vessel?	☐	☐
6. Check alignment of the mixer gears, shaft, or bearings?	☐	☐

You avoid *every one* of these needless "hidden costs" when you mix with seal-equipped LIGHTNIN Mixers.

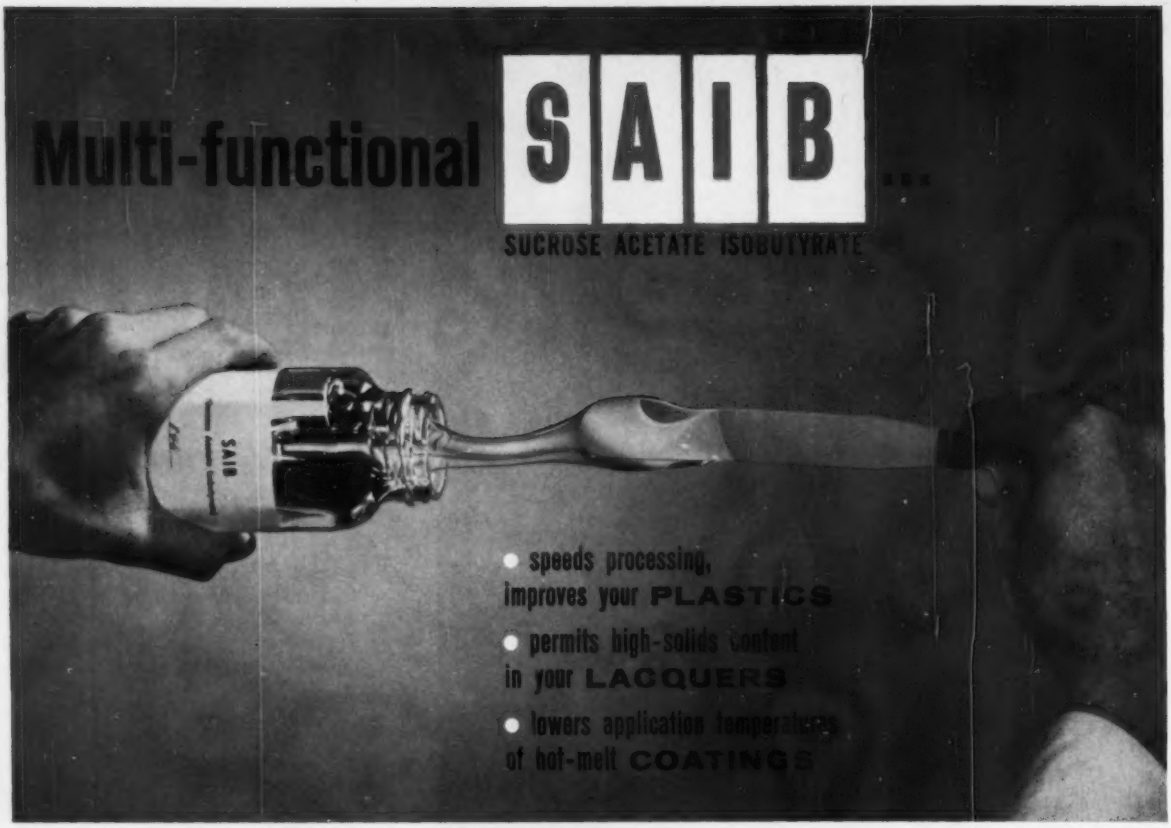


This seal could save you $1000 in case of a shutdown.

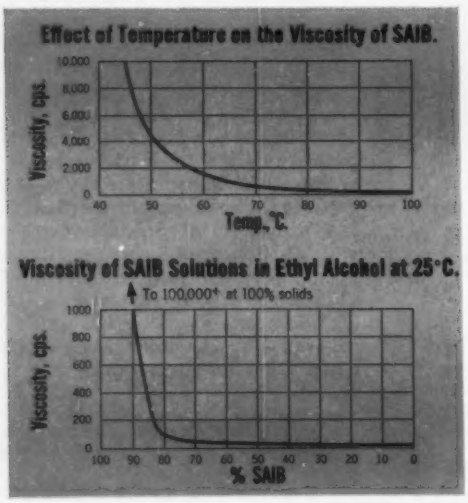
Lightnin® Mixers

MIXCO fluid mixing specialists

MIXING EQUIPMENT CO., Inc.
148-J Mt. Read Blvd., Rochester 3, N.Y.
In Canada: Greey Mixing Equipment, Ltd.
100 Miranda Ave., Toronto 19, Ont.
In Europe: Lightnin Mixers, Ltd.
Poynton, Cheshire, England


Multi-functional
SAIB
SUCROSE ACETATE ISOBUTYRATE
• speeds processing, improves your PLASTICS
• permits high-solids content in your LACQUERS
• lowers application temperatures of hot-melt COATINGS

Eastman's SAIB—Sucrose Acetate Isobutyrate—is truly a unique material. A semi-solid at room temperature, its viscosity (above 100,000 cps.) drops sharply with a rise in temperature, becomes only 100 cps. at 100°C. It is exceptionally soluble in most common lacquer solvents. The viscosity of a 50% solution of SAIB in ethyl alcohol, for example, is only 8 cps. And it is compatible with a wide variety of polymers, modifiers and plasticizers.



IN CELLULOSE ACETATE PLASTICS, formulated with dimethyl phthalate and similarly active plasticizers, SAIB provides easier dry blending, faster molding and extrusion rates, and improved physical properties.

IN LACQUERS, because of its wide compatibility and exceptional solubility, SAIB permits formulation of high-solids lacquers at practical application viscosities. In cellulose nitrate and cellulose acetate formulations SAIB can also be used to increase film hardness. In vinyl and acrylic coatings SAIB improves sprayability.

IN MELT COATINGS, the excellent compatibility, stability, and permanence characteristics of SAIB make it a useful modifier for hot melt and peelable plastic formulations. Tough, flexible melt coatings that won't fume at melt temperatures have been formulated containing up to 70% SAIB. Operating temperatures are also reduced.

SAIB is available either undiluted or as a 90% solution in ethyl alcohol. For samples, and a report on physical properties and performance data, call or write your nearest Eastman sales office.

SAIB
SUCROSE ACETATE ISOBUTYRATE

Eastman CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; Atlanta; Boston; Buffalo; Chicago; Cincinnati; Cleveland; Detroit; Greensboro, North Carolina; Houston; Kansas City, Missouri; New York City; Philadelphia; St. Louis.
Western Sales Representative: Wilson & Geo. Meyer & Company, San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

tial are probably the districts at Garland, northeast of Dallas with 5,000 acres of land, and at Richardson, north of the city. There are about 20,000 acres of industrial-site land available in the Dallas area, split half-and-half between inside-city limits and inside-Dallas-county limits.

Dallas also offers the lowest *ad valorem* tax rate of any major industrial city in Texas; stable city government; abundant labor (less than half of the manufacturing employees are unionized); water in amounts up to 1 million gal./day/customer.

Water Boom: Dallas was the first Texas city to go outside its natural watershed for future water supply, now taps the Sabine River about 50 miles east of the city. Previously, all water in the area came from the Trinity River system.

The city believes it has enough water to sustain growth of population and industry through the year 2000. Dallas area water consumption in 2000 is expected to average 500 million gal./day, with peak summer usage of 1 billion gal./day, more than five times the present consumption rate. By '63, the city expects to have completed treatment and distribution facilities that will form the basis for the ultimate water system 50 years from now. Several new dams and reservoirs are under construction. In the next decade, Dallas will spend over $110 million enhancing its supply.

Water Transport Dream: Development of the Trinity River Valley—from the Dallas-Fort Worth area to the Gulf of Mexico near Houston—will serve not only to improve the water supply but also to provide Dallas with its first navigable waterway. In '39, a Corps of Engineers' study found that it would be economical to make the Trinity navigable for barges up to Dallas, and predicted that justification for this would increase with time. A survey in '57 by the Trinity Improvement Assn. found that economic justification had doubled since '39.

Not until last fall, however, were the backers confident of success. That's when Houston—long a foe of putting Dallas and North Texas on navigable waterways — decided it might run low on water in the not-distant future and that the project to develop the Trinity River could prove

Why caustic and chlorine are Key Chemicals at Wyandotte
KEY CHEMICALS
Big volume? Long experience? Both count, and we have both. But far more significant than our total chlorine-caustic tonnage is the purity of every ounce of every order we ship. It's the highest. You can count on it: it's guaranteed. And long experience has full value only if it is put to work for the customer . . . ours is. May we put our experience to work for you?
WYANDOTTE CHEMICALS
MICHIGAN ALKALI DIVISION, WYANDOTTE, MICHIGAN

NEED SOLVENTS?

CALL US!

ESPESOL®

AROMATICS

INTERMEDIATES

ALIPHATICS

Use Espesol's ONE SOURCE-SUPPLY . . . Buy all your solvents at one place, at one time in compartment-lot quantities . . . save time, save money . . . eliminate late deliveries and production bottlenecks!

SIGNAL OIL AND GAS COMPANY
ESPESOL PRODUCTS

SIGNAL OIL AND GAS COMPANY

HOUSTON DIVISION

P. O. BOX 5008, HARRISBURG STATION, HOUSTON 12, TEXAS

an economic asset. Houston, Dallas, Fort Worth and other interested communities along the Trinity waterway sought—and received—action from Congress and the Corps of Engineers.

The president of the Trinity Improvement Assn. is Ben H. Carpenter of Dallas, head of the giant Southland Life of Dallas, which has built the 42-story Southland Life Building, second tallest building west of the Mississippi. Carpenter predicts the growth in population of the Trinity River area from the present 2.4 million to 6.5 million people in the next 50 years. He points out that the Trinity Improvement Assn. survey showed that about 14 million tons/year of barge traffic would travel to and from the Dallas area to the Intracoastal Waterway and the Gulf of Mexico. It also pointed out that the Trinity River runs through an area with reserves of 1 billion tons of iron ore and 2 billion tons of lignite, and through a giant oil and gas area of Texas.

The present timetable calls for field surveys to be completed on the 400-mile project late this year, which will be processed through various agencies for review until '63, with final authorization coming in '64, and first construction beginning in '65. At this rate, a system of twenty-six dams and locks and a barge channel 12 ft. deep and 150 ft. wide, should be completed by '70. On Sept. 15, '61 the Army Corps of Engineers will hold hearings in Forth Worth to present publicly for the first time the general Trinity development plan. Navigation has already been approved by Congress on the Trinity River as far north as Liberty, and dredging is completed from the coast to Anahuac, 20 miles upstream.

It is evident that the water carrier freight rates in Dallas will give a big boost toward attracting industry to the area—one of the drawbacks now for the CPI when Dallas is compared with the Houston area. Once the waterway project is under way, it is expected that the railroads will begin to lower freight rates for competitive reasons.

Oil, too: There are over 600 oil producers, drilling contractors and exploration companies located in Dallas. The Dallas Chamber of Commerce estimates that over 700,000 bbls./day of oil production is con-

Key Chemicals from Wyandotte

caustic and chlorine for the North

Every railroad, highway, and seaway in the North leads to Wyandotte's plant on the hub of the Great Lakes . . . or to a strategically located storage point. Users pick their mode of shipment for its most economical cost and convenience. Big volume and long experience have made caustic and chlorine Key Chemicals at Wyandotte. That means made right . . . and shipped right for you. Let us serve you.

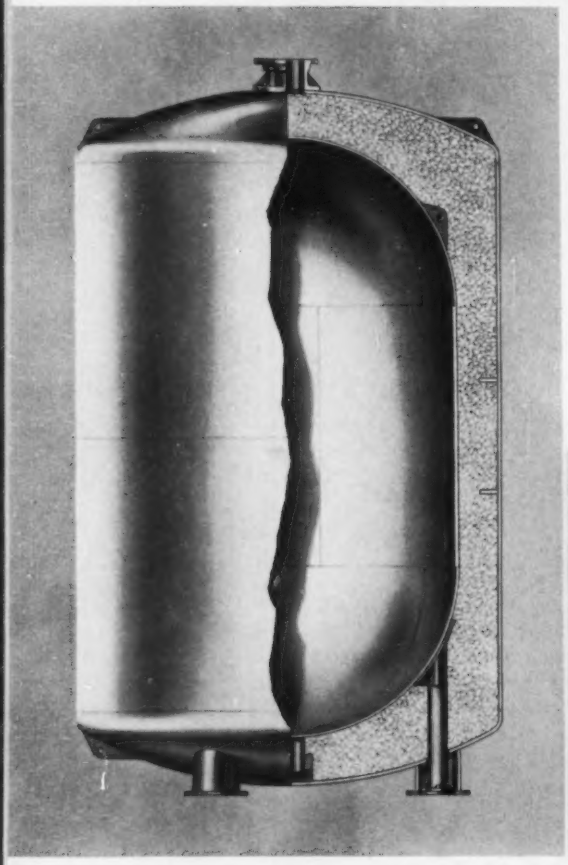
WYANDOTTE CHEMICALS

MICHIGAN ALKALI DIVISION, WYANDOTTE, MICHIGAN

FOR AIRCO

43 LIQUID OXYGEN TANKS

BY PDM



These 9% nickel 5850-gallon insulated liquid oxygen storage containers are now serving AIR REDUCTION customers around the country in the fields of missiles • steel • chemicals • metal fabrication.

This large order from Air Reduction Sales Company reflects the nationally recognized ability of Pittsburgh-Des Moines Steel Company to handle cryogenic storage vessel fabrication on schedule, to the most exacting specifications. Each of these units, supplied by AIRCO for in-plant customer use, consists of a 9% nickel inner tank 9′ dia x 16′3″ high, contained in a carbon steel outer tank 11′6″ x 20′ with vacuum-perlite insulation. The inner tank, built to ASME code, is grit-blasted, 100% X-rayed, nitrogen purged and stress relieved, hydrostatic tested, dried by hot filtered air and Freon de-greased. • May we quote on your requirements?

Left to right: Cutaway view of liquid oxygen unit, showing 9% nickel inner shell and vacuum-perlite insulation. • Inner tank under construction. • Shop view of carbon steel outer tank. • Completed unit undergoing mass spectrometer helium leak test.

PDM
STEEL STORAGE TANKS

PITTSBURGH-DES MOINES STEEL COMPANY

Plants at PITTSBURGH, WARREN, BRISTOL, PA. • BALTIMORE • BIRMINGHAM • DES MOINES
PROVO, UTAH • CASPER, WYO. • SANTA CLARA, FRESNO, STOCKTON, CALIF.

PITTSBURGH (25)	Neville Island	EL MONTE, CALIF.	P.O. Box 2012
WARREN, PA.	P.O. Box 660	NEW YORK (17)	200 East 42nd Street
BALTIMORE (26)	P.O. Box 3459, Curtis Bay Station	NEWARK (2)	744 Broad Street
BIRMINGHAM (8)	P.O. Box 8641, Ensley Station	CHICAGO (3)	679 First National Bank Bldg.
DES MOINES (8)	1015 Tuttle Street	ATLANTA (5)	361 East Paces Ferry Rd., N.E.
PROVO, UTAH	P.O. Box 310	DALLAS (1)	Suite 1703, Southland Center
SANTA CLARA, CALIF	P.O. Box 329	DENVER (2)	323 Railway Exchange Bldg.
	SEATTLE (1)	500 Wall Street	

trolled out of Dallas offices, which amounts to more than $500-million/-year in value.

Dallas is headquarters for several major oil companies—including Delhi-Taylor, the Hunt and the Murchison interests—and is operating headquarters for many others. Atlantic, Sun, and Mobil maintain research centers in Dallas, working on oil production and exploration problems.

The top three oil-field equipment manufacturers have home offices in Dallas. Moreover, Dallas banks and lawyers are known and used internationally for their services to the oil industry.

Manufacturers of transportation equipment are among Dallas' big employers. Ford has a huge automobile assembly line in Dallas and General Motors has a large plant west of Dallas. In addition, since WW II, the aircraft industry has shown tremendous growth in Dallas, with aircraft companies providing almost 40% of the total manufacturing employment growth from '40 to '58. Boating is big business in the Southwest, and Dallas has several of the largest manufacturers in the area, most of whom are large users of aluminum, resins, glass fibers and plastics in their construction.

Seven airlines, nine railroads, 40 common freight carriers and six federal interstate highways now serve the city. When navigable water is added to this transportation list, more chemical producers may well be making the trip.

KEY CHANGES

Morgan J. Davis to chairman of the board; **Carl E. Reistle, Jr.** to president, Humble Oil & Refining Co. (Houston).

H. E. Martin to chairman of the board and chief executive officer; **Charles J. Beasley** to president; **H. W. Buchanan** to executive vice-president, Metal & Themit Corp. (New York).

W. J. Price to vice-president of production, Western Petrochemical Corp. (Kansas City).

Raymond H. Herzog, Harry Heltzer to vice-presidents; **E. J. Kane, A. H. Redpath, R. W. Adam** to divisional vice-presidents, Minnesota Mining and Manufacturing Co. (St. Paul, Minn.)

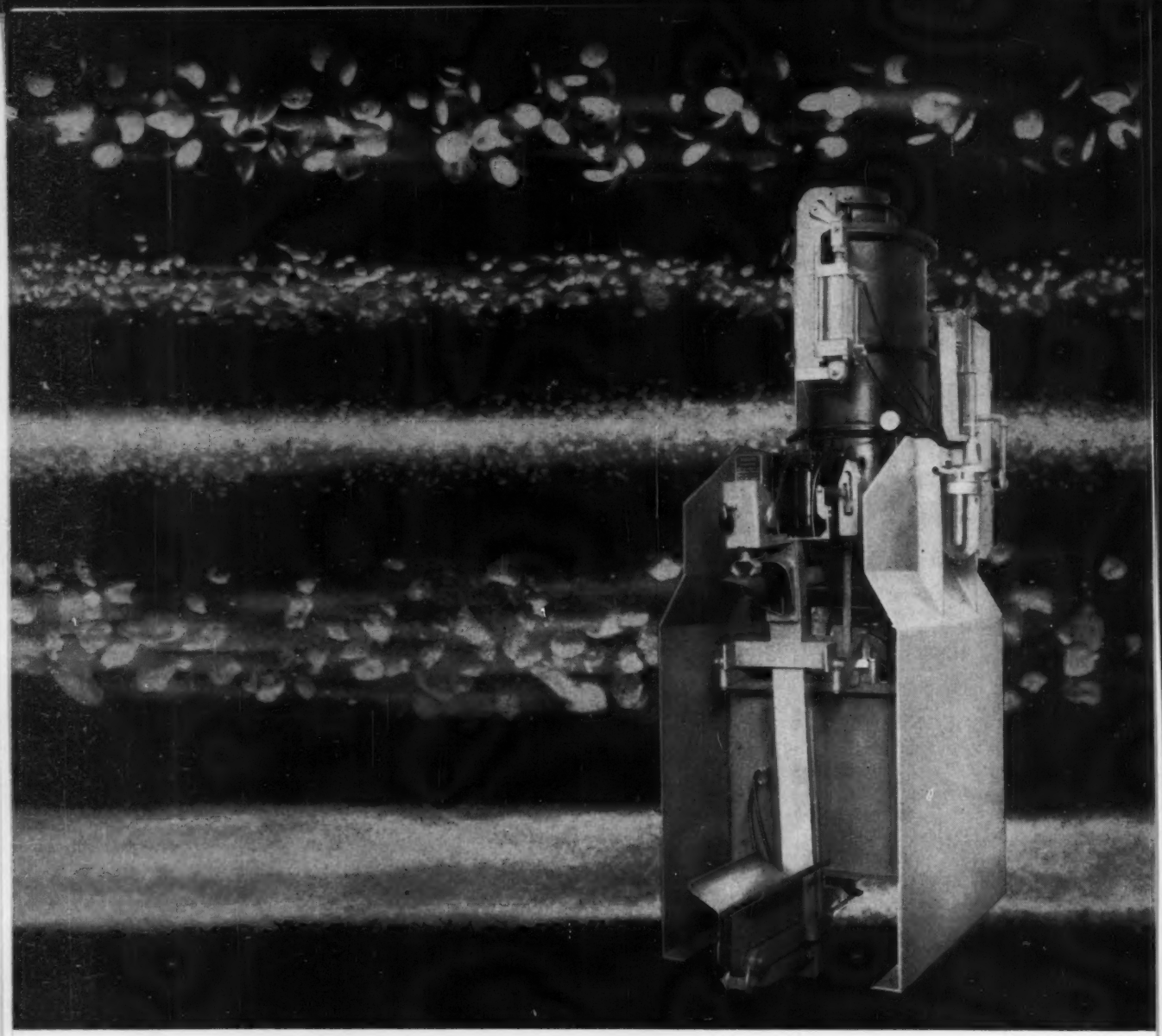
Key Chemicals from Wyandotte

caustic and chlorine for the South

By barge, rail, truck, or over the fence, Southern users can now draw on the capacity of Wyandotte's new Geismar plant. 335 tons of chlorine, 385 tons of caustic per day . . . produced with the same care that has made chlorine and caustic Key Chemicals at Wyandotte. We can ship economically and with dispatch. Which method of shipment is best for you?

WYANDOTTE CHEMICALS

MICHIGAN ALKALI DIVISION, WYANDOTTE, MICHIGAN



Pack anything from granules to powder with the St. Regis Force Flow* Packer

Now *one* machine – the St. Regis® Force Flow Packer – can be used to pack products with widely different flow characteristics, structures and sizes. Whether it's powder or granules such as carbon black or fertilizer, this *one* machine will pack them with accurate weights into smaller, cleaner bags.

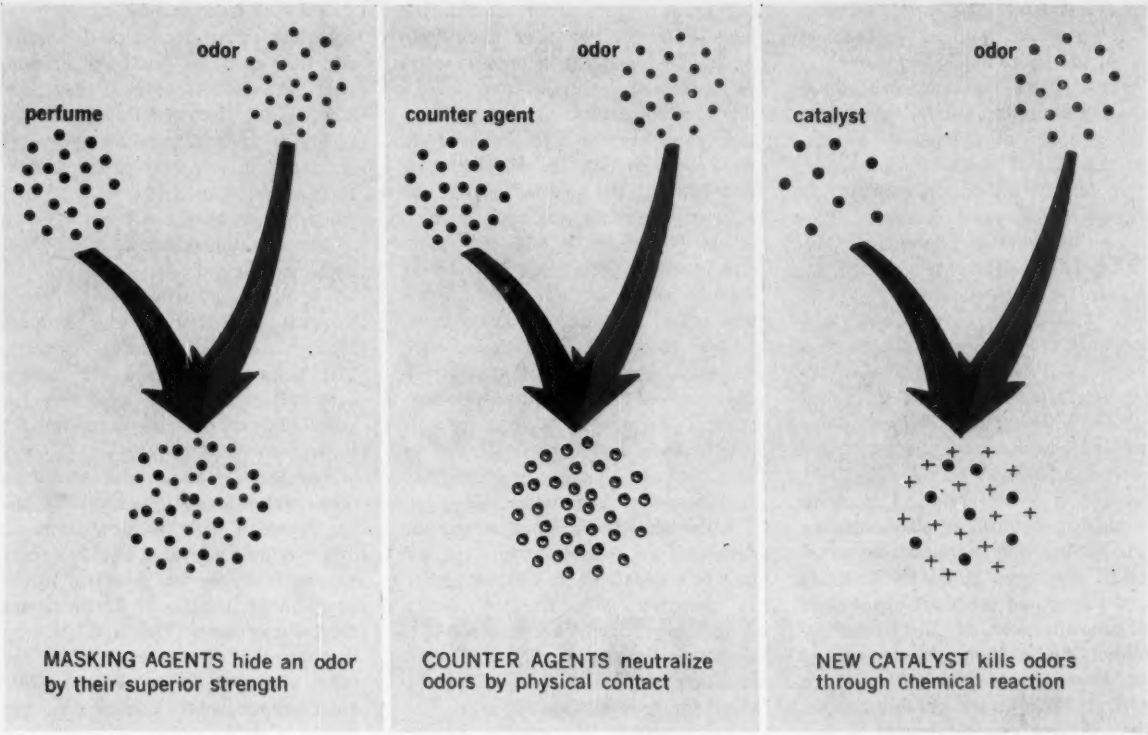
Completely successful during extensive use by leading chemical companies, the Force Flow may very well be the "universal packer" long sought by the industry. The advantages of this remarkable packer are outstanding: *Reduction in bag size on most products · Excellent weight accuracy · Reduction of dusting and spillage · High bagging rate · Reduction of head room requirements.*

Other special features of the Force Flow Packer include pneumatic-mechanical controls throughout, plus availability in 1, 2, 3 or 4-tube models.

The Force Flow Packer is another example of St. Regis *Packaging-in-Depth*. This complete bag service assures you of the *right* bag, the *right* machinery to pack it, plus skilled engineering services. To meet your *future* needs, this program also includes continued research to develop improved packaging methods and economies. *Trademark

PACKAGING·IN·DEPTH BY St.Regis BAG DIVISION

In Canada, contact St. Regis Consolidated Packaging Co., Ltd. PAPER COMPANY



MASKING AGENTS hide an odor by their superior strength

COUNTER AGENTS neutralize odors by physical contact

NEW CATALYST kills odors through chemical reaction

Killing Odors By Chemical Reaction

Chemical process plants with sulfide odor problems may be able to kill these smells by catalytic oxidation in open air. This week Rhodia Inc. (New York) reported that the oxidation technique is successful for hydrogen sulfide, methyl mercaptan, other alkyl mercaptans (which possess the odors of rotten eggs and cabbage) contained in stack gases from a kraft sulfate paper mill and an oil refinery. This approach to industrial odor control is an alternative to using existing control methods—e.g., masking and counter agents (see above).

Key to the method is a reportedly novel product called Alaxol SRM, developed by Rhodia. The product is said to be a mixture of inorganic and organic compounds (exact identity undisclosed). When added to stack gases it speeds up the oxidation of reduced sulfur compounds—either in the stack or ducts (if an oxidizing condition prevails) or else in the open atmosphere immediately surrounding the point of emission.

Alaxol is applied in the same manner as many counter agents used to neutralize odors. But Rhodia states that the Alaxol mixture kills odor by chemical reaction instead of counteraction, believes this method will prove more effective in controlling odors from sulfur compounds. (It says, however, that Alaxol is not to be regarded as a raw material for a process to recover sulfur.)

Smell Control in the Stack: The technique has been evaluated on a commercial scale. At a sulfate paper pulp mill operated by Champion Paper and Fiber Co. in Canton, N. C., the compound is sprayed into the base of the stack from the recovery section as well as into the gases from the digestor blowdown. And at Great Northern Oil Co.'s St. Paul, Minn., refinery, it is sprayed into the base of the stack from the coke drum blowdown. Officials at both plants are satisfied with the results.

At Champion's pulp mill the Alaxol is diluted to a 7% solution with water in a mixing tank, pumped through a 1-gal./minute gear pump to a discharge header from which it is distributed through five separate branch lines to the base of the recovery section stacks and to the tops of the blow-towers. Flow is measured by rotameters and controlled by solenoid valves activated by temperature instruments. This system gives automatic odor reduction both for the recovery section, which is operated continuously, and for the blow-towers, which are vented 120 times/day.

At Great Northern's refinery, the Alaxol is mixed with water and fed by proportioning pump to the base of a 100-ft. stack, which takes the blast from the coke drums as these are switched for decoking. Control is manual, with flow determined by the operators.

Costs and Concentrations: Alaxol is said to be effective on stack gases containing 25-200 parts/million of gaseous sulfides. On the basis of experience with the Champion plant, costs are estimated at 10-11¢/ton of finished pulp. This compares with a general cost of about 12¢/ton for

counter agents that can be used in paper mills. For both methods equipment is similar, and the installation cost for tanks, pumps, piping and sprays is almost negligible.

These costs, however, depend on the mill operation. And a more general estimate of costs may be calculated. Alaxol costs about 90¢/lb.; each pound will destroy about 50 lbs. of sulfides and disulfides. Prorating this figure to Champion's Canton mill indicates that 5-7 lbs. of sulfides are released for each ton of pulp. This compares with other sulfate pulp mills, where 9 lbs. of mercaptans and 18 lbs. of hydrogen sulfide are released per ton of pulp.*

This quantity of hydrogen sulfide pumped into the atmosphere can lead to dangerous concentrations of the gas and is a big argument in favor of catalyst control: it eliminates the gas, leaving only nontoxic elemental sulfur. Hydrogen sulfide is irritating to the eyes and mucuous membranes in concentrations of 20-150 parts/-million. And a 30-minute exposure to concentrations of 800-1000 may be fatal.** Well aware of this danger, firms making counter agents control their mixtures so that they can never neutralize the smell of hydrogen sulfide when the gas appears in concentrations greater than 20 parts/-million.

Perfume, Neutralize, or React: Although chemical treatments, e.g., ozone oxidation and chlorine wash are frequently used to kill odors inside process units, the cost of processing them to concentrations below the point at which they can be smelled in effluent gases is usually prohibitive. Hydrogen sulfide and methyl mercaptan, for example, have "threshold" concentrations (point at which they can be smelled) at less than 1 part/million.

A growing number of firms have therefore turned to two odor-control techniques: masking and counter agents. Masking agents use perfume (sassafras, wintergreen, citronella, pine odor, etc.) to dominate the objectionable smell. They're used in such products as scented toiletries, glues, have practically no industrial application. Counter agents — which neutralize the odor in a physical mixture—are used almost 100% in industrial odor control. The two methods differ in that the odor of a masking agent lingers, even after it has been removed. An odor neutralized by a counter agent returns as soon as the counter agent is removed from the odor molecules.

Counter agents are believed to work by simultaneous physical contact between the sensory nerves, the odor molecules and the counter agent (exact physiology is still uncertain). One aspect of the science is designing counter agents that will permeate the atmosphere and dissipate at the same rate as the smell. Formulating such agents, as well as those that will neutralize mixed odors, is a complex task. Airkem (New York), one of the largest U.S. manufacturers, says its mixtures may contain anywhere from 10-126 special ingredients.

Although Rhodia wont' reveal the details of its Alaxol mixture, its use may be compared with counter agents. In common with counter agents, Alaxol is specially formulated, uses similar equipment, is diluted for distribution with water and is finely divided for good mixing.

In contrast to counter agents, Alaxol has no characteristic odor that will appear with the end product; may require continuous agitation in the mixing tanks, because of the nonorganic catalysts present; continues to reduce the odor over longer periods as it is exposed to the odor molecules; and shows better odor-removing effects with improved surface contact.

Alaxol is said to be a new departure in odor control, complementing the historical application of masking agents and counter agents. Some of Rhodia's competitors are skeptical that the product can actually destroy odor-producing sulfur compounds; but Rhodia says that major tests, under way at an undisclosed plant, should confirm the material's catalytic action. In any event, the firm states that Alaxol is not a panacea but a step leading toward new techniques in odor control.

In the meantime, both counter agents and odor-control catalysts have plenty of growth room. Of some 160 kraft and sulfate pulp mills in the U.S., less than 10% are reported to be using odor control systems that go beyond the recovery of gases inside the processing units.

* *Tappi*, Vol. 39, No. 7, p. 195A
** *Dangerous Properties of Industrial Materials*, by Sax (Reinhold)

Combination Column

A novel fractionating column that combines the principles of distillation and heat exchange has been developed by A. G. Eickmeyer (Prairie Village, Kan.). The new device promises to find wide application in absorption units and in low-temperature separations that are used in oxygen, nitrogen and helium plants.

The new unit resembles a long heat exchanger turned on end. Key (covered by U.S. patent 2,944,966) is a bank of vertical tubes extending up through a series of distillation trays. The holes in the trays are slightly oversized to provide clearance for the liquid to flow down along the tubes.

The trays, resembling a shell-and-tube exchanger's segmental baffles, are provided with overflow weirs so that they hold a level of liquid. Vapors passing from one baffle-section to the next, move back and forth across the bank of tubes. The liquid leaking through the clearances around the tubes clings to the tubes to provide good vapor-liquid contact as the vapors pass by.

The system is expected to show economic advantages over many types of conventional distillation and absorption techniques. Heat exchange at each tray can improve reflux distribution, permitting better separation. And heat exchange from tray to tray can save on auxiliary equipment in those distillations where the condenser-reboiler system operates as a "heat pump" (where heat is removed through the overhead condenser and returned through the reboiler).

Coal Replaces Coke

The Hanna Furnace Corp. (Buffalo) is using coal as a partial replacement for coke in blast furnaces. The coal (crushed and screened) is fluidized by air agitation, injected through tuyeres via lances (*CW, July 8, '61, p. 63*). Costing $4-10/ton vs. $15-20 for coke, coal thus joins the list of less-expensive fuels—e.g., natural gas, fuel oil—that are finding use in the blast furnace. Hanna Corp. says that it has already been successful in reducing the coke requirements by about 20%. And it expects to increase this to 30% next month.

Shell has three benzene-producing refineries, located near waterways. Barges like these will carry the bulk of 1961's record output.

BULLETIN:

Shell has increased benzene production to meet your rising needs—capacity now exceeds 80 million gallons per year

Shell has increased its benzene production nearly 500 percent in less than 18 months. Shell's benzene-producing capacity in the U. S. is now the largest in the world.

Shell's stepped-up output comes to you via a nationwide supply network served by 3 refineries.

Read how Shell's increased benzene production can help you meet your rising benzene requirements now.

WITH DEMAND for benzene at an all-time high, and with new uses coming along each year, Shell is producing more benzene now than ever before.

Bigger supplies now

Shell has stepped up production of benzene again. Shell's capacity has already topped 80 million gallons of high purity benzene. *And Shell has nationwide facilities for producing and distributing benzene.*

Widest distribution

Shell Benzene is produced at three refineries. At Wood River, Illinois; Houston, Texas; and Wilmington, California.

NOTE: All three refineries are located near waterways. You can take delivery of Shell Benzene in barges, in tank cars and transport trucks. Deliveries can come direct from the refinery.

Manufacturers choose Shell Benzene when precise control is vital. Its quality is consistently high.

And it is free of Thiophene.

For full facts on Shell Benzene, contact your Shell Industrial Products Representative. Or write: Shell Oil Company, 50 West 50th Street, New York 20, N. Y.

SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are working to provide better products for industry

Chemical Week
ADVERTISERS' INDEX

AIR REDUCTION CHEMICAL & CARBIDE CO., A DIV. OF AIR REDUCTION CO., INC. Agency—E. M. Freystadt Assoc., Inc. 25

AIR REDUCTION SALES CO., A DIV. OF AIR REDUCTION CO., INC. Agency—G. M. Basford Co. 92

ALLIED CHEMICAL CORP., NITROGEN DIV. Agency—G. M. Basford Co. ... 32

ALLIED CHEMICAL CORP., SOLVAY PROCESS DIV. Agency—Kastor, Hilton, Chesley, Clifford & Atherton, Inc. ..... 2nd cover

AMERICAN CYANAMID CO., PROCESS CHEMICALS DEPT. Agency—Erwin Wasey, Ruthrauff & Ryan, Inc. 23

AMERICAN OPTICAL CO. Agency—Fuller & Smith & Ross, Inc. 55

ARIZONA CHEMICAL CO. Agency—Erwin Wasey, Ruthrauff & Ryan, Inc. .. 85

BADGER MFG. CO. Agency—F. P. Walther, Jr. & Assoc. 13

BAKER CHEMICAL CO., J. T. Agency—Wildrick & Miller, Inc. 9

BAKER PERKINS, INC. Agency—Price, Tanner & Willox, Inc. 27

BEMIS BRO. BAG CO. Agency—Gardner Advertising Co. 8

BENZOL PRODUCTS CO. Agency—The House of Twiss, Inc. 31

CELANESE CHEMICAL CO. Agency—Ellington & Co., Inc. 104

CHEMICAL SOLVENTS, INC. Agency—Asher, Rosston & Kremer, Inc. ... 95

CHICAGO BRIDGE & IRON CO. Agency—Ladd, Southward & Bentley, Inc. 77

CLUPAK, INC. Agency—Lennen & Newell, Inc. 21

COWLES CHEMICAL CO. Agency—The Bayless-Kerr Co. 11

DAWES LABORATORIES, INC. Agency—Don Kemper Co., Inc. 76

DAY CO., THE J. H. Agency—The Keelor & Stites Co. 22

DELHI TAYLOR OIL CORP. Agency—Sam J. Gallay Advertising 101

DISTILLATION PRODUCTS INDUSTRIES, DIV. OF EASTMAN KODAK CO. Agency—The Rumrill Co., Inc. 112

DIXON CHEMICAL & RESEARCH, INC. Agency—Ray Ellis Advertising 2

DOW CHEMICAL CO., THE Agency—MacManus, John & Adams, Inc. 78

DOW CORNING CORP. Agency—Church & Guisewite Adv., Inc. 6

DRACCO DIV. FULLER CO. Agency—The Jayme Organization, Inc. 1

DU PONT DE NEMOURS & CO., E.I., EXPLOSIVES DIV. Agency—The Rumrill Co., Inc. 28

EASTMAN CHEMICAL PRODUCTS, INC. Agency—Fred Wittner Co. 118

EMERY INDUSTRIES, INC. Agency—Farson, Huff & Northlich, Inc. 14-15

ENJAY CHEMICAL CO., A DIV. OF HUMBLE OIL & REFINING CO. Agency—McCann-Erickson, Inc. 81

FOSTER WHEELER CORP. Agency—Arndt, Preston, Chapin, Lamb & Keen, Inc. 4-5

FRONTIER CHEMICAL CO. Agency—The McCormick-Armstrong Co. 88

HARCHEM DIV. WALLACE & TIERNAN, INC. Agency—Barber & Drullard, Inc. 96

HERCULES POWDER CO. Agency—Fuller & Smith & Ross, Inc. 109

HOOKER CHEMICAL CORP. Agency—The Rumrill Co., Inc. 61

HUMKO PRODUCTS CHEMICAL DIV. OF NATIONAL DAIRY PRODUCTS CORP. Agency—Wilk Advertising, Inc. 56

JOHNS MANVILLE CORP. Agency—Cunningham & Walsh, Inc. 26

LUCIDOL DIV., WALLACE & TIERNAN, INC. Agency—Barber & Drullard, Inc. 97

MANTON GAULIN MFG. CO. Agency—Sutherland-Abbott Advertising ... 42

MARATHON DIV. OF AMERICAN CAN CO., CHEMICAL SALES DEPT. Agency—Maercklein Advertising 108

METAL HYDRIDES, INC. Agency—Creamer-Trowbridge & Case, Inc. 91

MIXING EQUIPMENT CO., INC. Agency—The Rumrill Co., Inc. 117

MOREHOUSE-COWLES, INC. Agency—Willard G. Gregory & Co. 58

NATIONAL CARBON CO., DIV. OF UNION CARBIDE CORP. Agency—J. M. Mathes, Inc. 106

NATIONAL MARINE SERVICE, INC. Agency—Bozell Jacobs, Inc. 98

NEVILLE CHEMICAL CO. Agency—Bond & Starr, Inc. 107

OLIN MATHIESON CHEMICAL CORP., MATHIESON CHEMICALS Agency—Van Sant Dugdale & Co., Inc. 24

OWENS ILLINOIS GLASS CO. Agency—J. Walter Thompson Co. 87

PATTERSON KELLEY CO., INC. Agency—G. M. Basford Co. 16

PENNSALT CHEMICALS CORP. Agency—The Aitkin-Kynett Co., Inc. ... 84

PFAUDLER DIV., PFAUDLER PERMUTIT, INC. Agency—The Rumrill Co., Inc. 102-103

PHILADELPHIA QUARTZ CO. Agency—The Michener Co. Adv. 110

PITTSBURGH DES MOINES STEEL CO. Agency—Downing Industrial Advertising 122

PORTLAND PUBLIC DOCKS Agency—Richard G. Montgomery & Assoc., Inc. 60

PRIOR CHEMICAL CORP. Agency—Robertson Martin Advertising 94

QUAKER OATS CO. Agency—Headen, Horrell & Wentsel, Inc. 36

REPUBLIC STEEL CORP. Agency—Meldrum & Fewsmith, Inc. 12

RESISTOFLEX CORP. Agency—Adams & Keyes, Inc., Adv. 29

REYNOLDS & CO. Agency—Doremus & Co. 74

RHEEM MFG. CO. Agency—Marsteller, Rickard, Gebhardt & Reed, Inc. .. 75

ROHM & HAAS CO., RESINOUS PRODUCTS DIV. Agency—Arndt, Preston, Chapin, Lamb & Keen, Inc. 17-20

ST. REGIS PAPER CO. Agency—Cunningham & Walsh, Inc. 124

SCIENTIFIC DESIGN CO. Agency—Michel Cather, Inc. ..... 4th cover

SHARPLES CORP., THE Agency—The Aitkin-Kynett Co. 35

SHELL OIL CO. Agency—Ogilvy, Benson & Mather, Inc. 127

SILICONES DIV. UNION CARBIDE CORP. Agency—J. M. Mathes, Inc. 83

SINCLAIR PETROCHEMICALS, INC. Agency—Geyer, Morey, Madden & Ballard, Inc. ..... 3rd cover

SIGNAL OIL & GAS CO. Agency—Erwin Wasey, Ruthrauff & Ryan, Inc. 120

SMITH, INC., WERNER G. Agency—Kasper Advertising 94

TENNESSEE CORP. Agency—Crawford & Porter, Inc. 82

TEXAS GULF SULPHUR CO. Agency—Sanger Funnell, Inc. 10

TOLEDO EDISON CO. Agency—Beeson-Reichert, Inc. 86

TRUBEK LABORATORIES, THE Agency—Ray Ellis Advertising 111

UNION CARBIDE CHEMICALS CO., DIV. OF UNION CARBIDE CORP. Agency—J. M. Mathes, Inc. 59

U.S. INDUSTRIAL CHEMICALS CO., DIV. NATIONAL DISTILLERS & CHEMICAL CORP. Agency—G. M. Basford Co. 113-114

VIRGINIA ELECTRIC & POWER CO. Agency—Cargill Wilson Adv., & Acree, Inc. 30

VANDERBILT CO., R. T. Agency—Pearsall & Schael 112

VICTOR CHEMICAL WORKS DIV. OF STAUFFER CHEMICAL CO. Agency—The Buchen Co. 62-71

WINTHROP LABORATORIES, INC. Agency—Thompson-Koch Co. 95

WISCONSIN ALUMNI RESEARCH FOUNDATION Agency—Arthur Towell, Inc. 110

WOLF DIV., JACQUES, NOPCO CHEMICAL CO. Agency—Gray & Rogers Advertising 76

WYANDOTTE CHEMICALS CORP. Agency—Ross Roy, B.S.F. & D., Inc. Inc. 119, 121, 123

ADVERTISING STAFF

Atlanta 9 ..... Michael Miller
1375 Peachtree St., N.E. TRinity 5-0523

Boston 16 ..... Paul F. McPherson
Copley Square, COngress 2-1160

Chicago 11 ..... Alfred D. Becker, Jr., R. J. Claussen, 645 N. Michigan Ave., MOhawk 4-5800

Cleveland 13 .. H. John Sweger Jr., Duncan C. Stephens
1164 Illuminating Bldg., 55 Public Square, SUperior 1-7000

Dallas 1 ..... John Grant
901 Vaughan Bldg., 1712 Commerce St., Riverside 7-9721

Denver 2 ..... J. Patten,
1740 Broadway, ALpine 5-2981.

Detroit 26 ..... H. John Sweger, Jr.,
856 Penobscot Bldg., WOodward 2-1793

Frankfurt/Main ..... Stanley Kimes,
Westendstrasse 85, Germany

Geneva ..... Michael R. Zeynel
2 Place du Port, Geneva, Switz.

Houston 25 ..... Don Hanson
W-724 Prudential Bldg., JAckson 6-1281

London W1 ..... E. E. Schirmer, N. Murphy,
McGraw-Hill House, 34 Dover St., England.

Los Angeles 17 ..... Robert Yocom,
1125 West Sixth St., HUntley 2-5450

New York 36 .... Charles Haines, Bruce A. Johnson, Paul F. McPherson, Charles F. Onasch, L. Charles Todaro, 500 5th Ave., OXford 5-5959

Philadelphia 3 ..... William B. Hannum, Jr., J.E.B. Ladouceur & Penn Center Plaza, LOcust 8-4330

Pittsburgh 22 ..... Duncan C. Stephens
4 Gateway Center, EXpress 1-1314

Portland 4 ..... Scott B. Hubbard
Room 445, Pacific Bldg., CApitol 3-5118

St. Louis 8 ..... R. J. Claussen
3615 Olive St., Continental Bldg., JEfferson 5-4867

San Francisco 11 ..... William C. Woolston
255 California St., Douglas 2-4600

ALUMINA CHEMISTS

Immediate opening for two competent physical chemists or solid state physicists experienced in inorganic research and possessing advanced degrees. Work will consist of the planning, execution, and analysis of projects involving research on development and applications of all phases of the aluminas and of aluminum chemicals including:

1. **Preparation, calcination, activation, sintering, fusion, effect of impurities and additives, phase transformation, particle and crystallite size control, etc.**
2. **Studies of rheology of dispersoids, slurries and pastes, including effects of particle size, of surface adsorption and reactivity, and effects of additives; absorption of gases and liquids and of impurities therein; gelatin dispersion and preparation.**

These openings particularly available to young men with limited experience but highly applicable educational background and desirous of constantly increasing challenge and responsibility. Give complete background, including salary required, in confidential letter. **P7374 Chemical Week 645 N. Michigan Ave., Chicago 11, Ill.**

An equal opportunity employer.

ASK...

the man from CHEMICAL WEEK what you can do to merchandise your exhibit at the 28th EXPOSITION OF CHEMICAL INDUSTRIES. Investigate CW's special "CHEM SHOW REPORT" . . . today!

Tracers

TO THE CHEMICAL PROCESS INDUSTRIES

Published: each Saturday— closes 11 days in advance.

Rate—$3.00 per line (1.50 per line for position wanted ads), minimum 3 lines. Allow 5 average words as line; Count on half line for box number.

ADDRESS BOX NO. REPLIES TO:
BOX NO.———
Classified Adv. of this Publication
Send to Office nearest you.
P.O. Box 12, New York 36, N. Y.
645 N. Michigan Ave., Chicago 11, Ill.
255 California St., San Francisco 11, Calif.

POSITIONS VACANT

Wanted-The services of a qualified Chemist or C/E age 28 to 40, healthy, willing to work and take responsibility, working in Lab, Plant, Road and generally Assistant to the Manager. Party must have accredited college degree as well as experience in the field of Water Treatments for boilers and cooling systems. Write or contact, state salary expected, to National Chemical Sales Co., Inc.—414 Sixth Street, N.W., Atlanta, Georgia.

Nationally known manufacturer of waxes and polymers wishes to employ technical sales representative having a minimum of five years experience in the sales of waxes, polyethylene or resins to the polish, carbon paper, waxed paper, carton and container, printing ink industries. Excellent opportunities for highly qualified, experienced, and aggressive individuals capable of developing new markets for new products. Age is not a consideration but a more mature man is preferred. Formal education unimportant-what counts is experience and salesmanship. Must be willing to travel-first year, 75% of the time, thereafter, 50% of the time. Send all particulars and salary requirements to P-7412, Chemical Week.

European Chemical Co. has need for a consul- tant in Polyamides molding compounds. We demand Manufacturing-selling and application know-how. Contact Havas No. 217/598, Rue Vivienne 17, Paris.

Independent CO_2 producer in southwest has ex- cellent oportunity for self starting high calibre salesman to head up multi-state operation. Must be experienced and capable in sales and distribution of dry ice, bulk liquid, and cylinder CO_2 sales. Must have proven management ability. Right man may or may not purchase part interest as he desires. An excellent opportunity for right man to join a successful team and contribute to its progress in a fast-growing area. Give full information in first letter. Write in confidence to P-7149, Chemical Week.

POSITION WANTED

Market Development Sales Advertising Chemical Engineer, age 36. Successful achievements chemical pharmaceutical industries seeks growth opportunity. PW-7354, Chemical Week.

Business Development-Sales, experienced field sales, management, process engineering, eastern location desired, BSChE, age 45. PW-7437, Chemical Week.

Your Organization-is it complete? Are you ex- panding it? Making replacements? Naturally, you are anxious to secure the most suitable man or men available. You want men with the special training that will make them an asset to your organization. You can contact such men through an advertisement in this Tracers Section of Chemical Week. Classified Advertising Division, Chemical Week, Post Office Box 12, New York 36, New York.

SELLING OPPORTUNITY WANTED

Sales Representative—Experienced in surfactants to cosmetics, detergent and chemical industries. Willing to relocate if necessary. Excellent benefits, car and expenses. Reply to Stepan Chemical Co., Edens & Winnetka, Northfield, Illinois.

SELLING OPPORTUNITY WANTED

Experienced Chemical Salesman. Selling various industries including Cosmetic, Chemical Specialty and Pharmaceutical in the East. Proficient in product development and new material promotion. Technical and business background. RA-7414, Chemical Week.

BUSINESS OPPORTUNITY

European Common Market: Progressive Manu- facturer with plant in France and extension facilities, is interested in new chemicals or plastic products for possible manufacture under license. Reference will be given. Please write to Havas no. 242/598 Rue Vivienne 17 Paris-France.

Opportunities-business; personal or personnel; financial; equipment; etc., may be offered or located through the Tracers Section of Chemical Week. For more information write to: Classified Advertising Division, Chemical Week, Post Office Box 12, New York 36, New York.

MISCELLANEOUS

To Employers Who Advertise for Men: The letters you receive in answer to your advertisements are submitted by each of the applicants with the hope of securing the position offered. When there are many applicants it frequently happens that the only letters acknowledged are those of promising candidates. (Others do not receive the slightest indication that their letters have even been received, much less given any consideration.) These men often become discouraged, will not respond to future advertisements and sometimes even question if they are bona fide. We can guarantee that Every Advertisement Printed Is Duly Authorized. Now won't you help keep our readers interested in this advertising by acknowledging every application received, even if you only return the letters of unsuccessful applicants to them marked say, "Position filled, thank you." If you don't care to reveal your identity, mail them in plain envelopes. We suggest this in a spirit of helpful co-operation between employers and the men replying to Positions Vacant advertisements. Classified Advertising Division, McGraw-Hill Publishing Company, "Put Yourself in the Place of the Other Fellow."

EQUIPMENT FOR SALE

Multi-million dollar chemical plant at North Little Rock, Ark. Stainless Steel & glass-lined equip. Send for detailed circular. Perry, 1415 N. 6th St., Phila. 22, Pa.

Pfaudler 1250 gal. blue-glass lined jacketed reactor, 72″ x 72″, Agit. Perry, 1415 N. 6th St., Phila. 22, Pa.

2600 gal. T316 SS tank, 7′ x 8′ dished heads, coils, Perry, 1415 N. 6th St., Phila. 22, Pa.

For Sale:—Over 80,000 Gallons A. O. Smith Blue Glass-lined Storage Tanks still erected in closed Newark, New Jersey brewery. Available at once. Arrange for inspection now. For details, contact Frank Boitz in Newark at Bigelow 8-6161 or Bigelow 8-3400 or write c/o P. O. Box 3055. Newark 3, New Jersey.

CHEMICALS WANTED

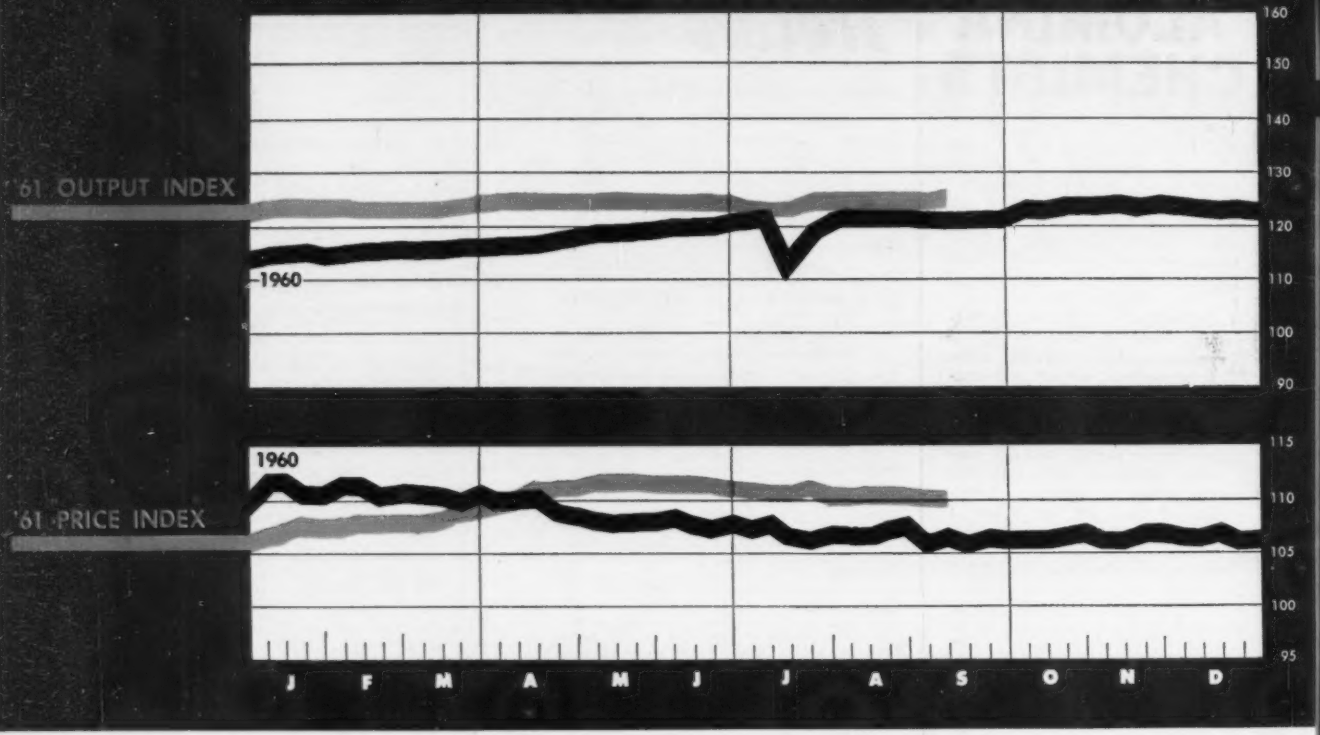
C_6-C_{10} Alcohols (C_8 Av.). Off-grade, low-cost. Prime sources large continuous quantities wanted. Send details to W-7391, Chemical Week.

Surplus Wanted—Chemicals, Pharmaceuticals Oils, Acids, Plasticizers, Resins, Dyes, Solvents, Pigments, Etc. Chemical Service Corporation, 96-02 Beaver Street, New York 5, N.Y. HAnover 2-6970.

WANTED/FOR SALE

This Tracer Section can be used whenever you are looking for or offering Equipment, Plants, Supplies, Chemicals, Opportunities, Special Services. The rates are low—just call or write Classified Advertising Division, Chemical Week, P.O. Box 12, N. Y. 36, N. Y. LOngacre 4-3000.

BUSINESS BENCHMARKS



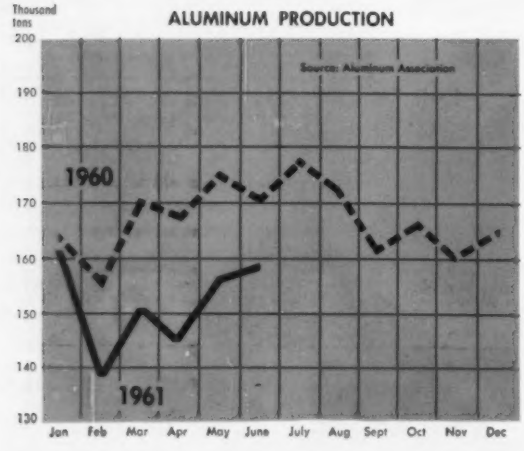
SEPTEMBER 9, 1961

WEEKLY BUSINESS INDICATORS	Latest Week	Preceding Week	Year Ago
Chemical Week output index (1957=100)	125.5	124.9	122.2
Chemical Week wholesale price index (1947=100)	110.6	110.3	107.0
Stock price index (12 firms, Standard & Poor's)	55.21	56.01	48.39
Steel ingot output (thousand tons)	2,020	1,944	1,547
Electric power (million kilowatt-hours)	15,491	15,665	15,018
Crude oil and condensate (daily av., thousand bbls.)	7,054	7,073	6,846

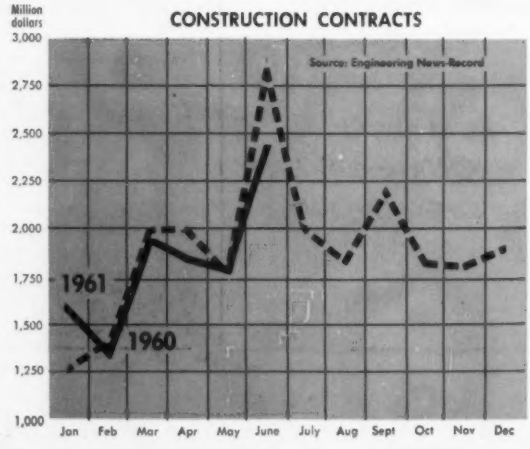
MONTHLY INDICATORS—Wholesale Prices (1947-49=100)	Latest Month	Preceding Month	Year Ago
All commodities (other than farm & foods)	127.4	127.4	128.2
Chemicals and allied products	108.9	109.3	110.4
Industrial chemicals	121.1	122.2	124.7
Paint and paint materials	120.8	120.8	120.2
Drugs, pharmaceuticals and cosmetics	92.5	92.4	95.1
Fats and oils (inedible)	52.1	54.1	47.8
Fertilizer and materials	111.7	112.3	110.4

CHEMICAL CUSTOMERS CLOSE-UP

ALUMINUM PRODUCTION



CONSTRUCTION CONTRACTS



WE'VE BROUGHT CLEOPATRA'S BARGE UP TO DATE

In our picture, you'll notice Cleo's eyes are quite wide. They should be, for we've loaded her barge with a few thousand things she never heard of... but which modern industry is producing from Sinclair petrochemicals.

For example, in the plastics and synthetic fibres industries Sinclair petrochemicals are indispensable raw materials being used in the development of countless new and exciting products. Even when you add the new developments in paints, fertilizers, insecticides and detergents, you've only scratched the surface of profitable opportunities.

Sinclair supplies quality petrochemicals in quantity. Shipping and production schedules are set up to meet the most stringent demands. The purity of Sinclair petrochemicals sets industry standards.

SINCLAIR PETROCHEMICALS, INC.

600 Fifth Avenue, New York 20, N. Y. • 155 N. Wacker Drive, Chicago 6, Ill.

Sinclair

PARAXYLENE—PROPYLENE (99+%)—ORTHOXYLENE—HEPTENES—NONENES—DURENE (1,2,4,5-TETRAMETHYLBENZENE)—AROMATIC SOLVENTS—TOLUENE (NITRATION GRADE)—XYLENE (FIVE DEGREE)—ALIPHATIC SOLVENTS—ODORLESS SOLVENTS—MINERAL SPIRITS—VM&P NAPHTHA—RUBBER SOLVENT—ANHYDROUS AMMONIA—AQUA AMMONIA—AMMONIUM NITRATE SOLUTIONS—NITROGEN FERTILIZER SOLUTIONS—SULFUR—LUBE OIL ADDITIVES

EXCITING DEVELOPMENTS
FOR THE CHEMICAL INDUSTRY

SCIENTIFIC DESIGN
increases its lead in Phthalic Anhydride from Ortho-Xylene and Naphthalene

SD'S UNIQUE ORTHO-XYLENE CATALYST IN COMMERCIAL OPERATION produces phthalic anhydride in plant of major chemical company, thus proving out this SD convertible catalyst which works equally well with ortho-xylene and/or naphthalene.

DUTCH STATE MINES places new SD phthalic plant onstream, achieving rapid, full startup with no operating difficulties.

FRANCOLOR (Compagnie Française des Matieres Colorantes) is nearing completion of an SD plant designed specifically to produce phthalic from ortho-xylene using SD's convertible catalyst.

WITCO'S phthalic anhydride plant in Chicago, Illinois, designed and built by SD, has been operating successfully for almost two years. A second plant for Witco Chemical Company is now under construction at Perth Amboy, New Jersey.

These and other commercial operations prove that SD's unique phthalic process provides:

- **LOW capital investment**
- **HIGH yields**
- **HIGH product purity**

We will be happy to send you on request our comprehensive review of phthalic anhydride processes.

SCIENTIFIC DESIGN COMPANY, INC.
EXECUTIVE OFFICES: TWO PARK AVENUE, NEW YORK 16, NEW YORK
International Leader in Development, Design and Construction of Chemical Plants